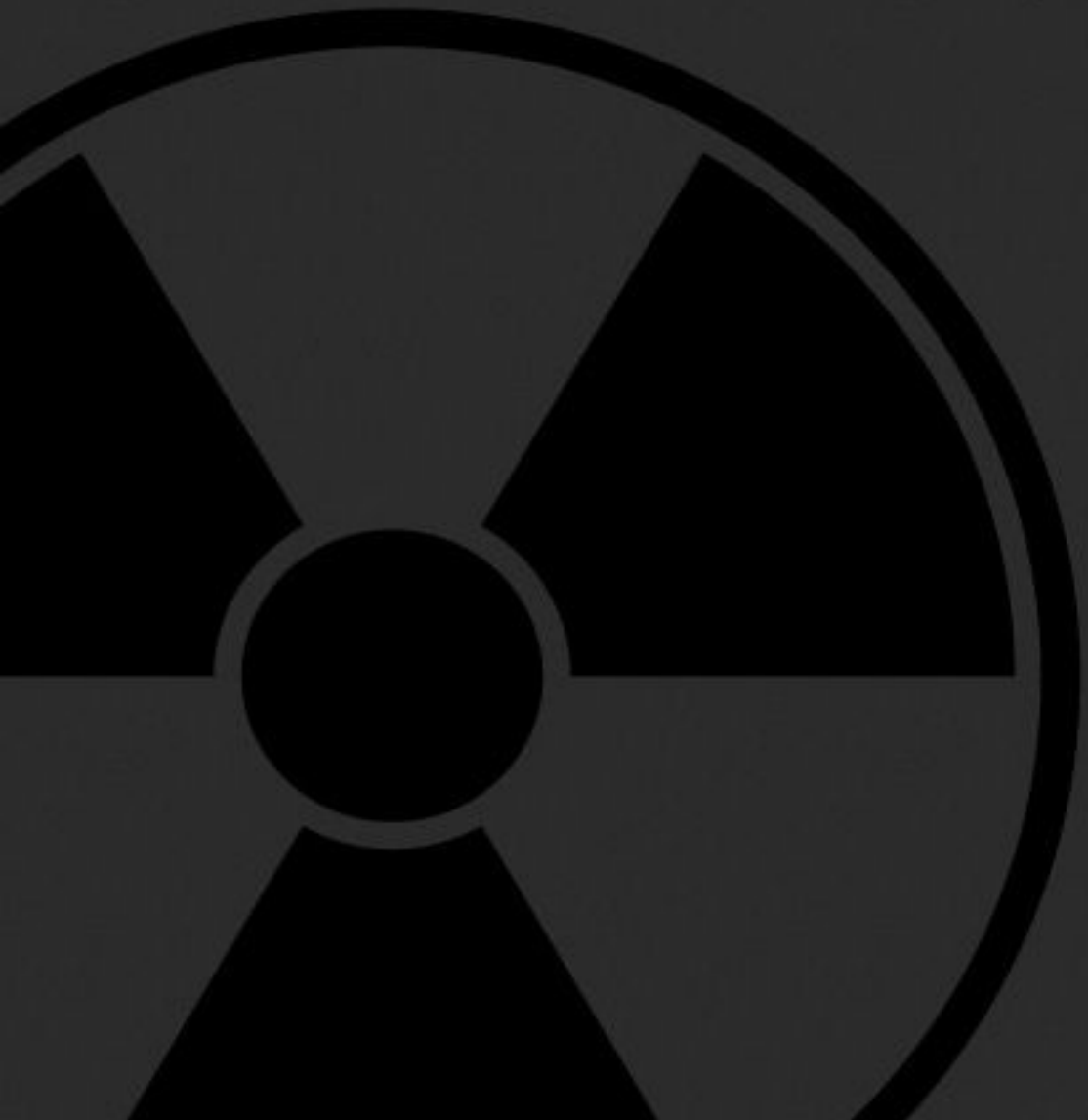
Chernobyl Notebook

By Grigoriy Medvedev



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Preface by S. Zalygin

It is not possible to avert disasters without knowing their causes and all the causal circumstances. By now, this is clear to everyone, now this is one of the most important principles of restructuring and of our present-day existence.

And if we do not want to betray our principles and ourselves, there must be no exceptions here. Not a single one.

The possibility of one or two, well, perhaps three, exceptions—after all, this does as a matter of fact have a calming effect on society, but what might that ease of mind cost it in the future. Perhaps the immediate future. Nothing other than a repetition of the disaster. It may occur in a different version, but it will occur.

There is only one road here: the most thorough study of all the details of the Chernobyl disaster, since it is by no means precluded that one of the details of it that is overlooked today will sometime be the main cause of the next calamity or the one after that.

It was considerations of this kind that presented the editors with the necessity of publishing G. U. Medvedev's documentary narrative, although in some respects it is not tactful and will wound some people's pride and perhaps even their dignity, as it reveals the unsightly situation, whose "unsightliness" we will have to analyze over and over again, even if we have an inner reluctance to undertake that analysis. Yet why should we be reluctant when we are talking about the future of our children and grandchildren?

Yes, there is the dictate of the heart, there is the dictate of the mind, but there are harsh dictates of both mind and heart.

G.U. Medvedev's "Chernobyl Notebook" is a competent and dispassionately truthful account of the tragedy that occurred more than 3 years ago and which is continuing to disturb millions of people. This is perhaps the first time we have such a complete first-hand account in which nothing is kept back and there is no departmental "diplomacy." The author is a nuclear power specialist who worked for a time at the Chernobyl AES and knows it well, just as he is personally acquainted with all the principal participants in the events. By virtue of his

official position, he has attended many of the crucial conferences concerning nuclear power plant construction. Immediately after the accident, Medvedev was sent to Chernobyl and had an opportunity to learn a great deal while the trail was still fresh and to see things with his own eyes. He presents many technical details indispensable to understanding the mechanism whereby the accident occurred, he exposes the secrets of bureaucratic relations, he tells about the oversights of scientists and designers, about the disastrous overbearing pressure in the command system, about the violations of glasnost before the accident and in the emergency situation following it that have caused enormous harm. The chronicle of events at Chernobyl in the tragic days of April and May 1986 takes up the central place in the story. The author portrays the behavior and role of numerous participants in the drama, of real living people with their shortcomings and virtues, their doubts, their weaknesses, their illusions, and their heroism alongside the nuclear monster that had gone out of control. It is not possible to read about this without the deepest emotion. We knew about the exploits of the firemen. The author tells about the heroism of the electricians, the turbine specialists, the operators, and other workers at the station who prevented the accident from taking on greater proportions.

Everything that pertains to the Chernobyl disaster, its causes and consequences, must become the property of glasnost. The complete and naked truth is necessary. People must be able to arrive at their own opinion of something that concerns so directly the life and health of each of us and our descendants, and must have the right to take part in making the key decisions that determine the destiny of the country and the planet. Should nuclear power engineering develop at all? If so, then is it permissible to build reactors located on the surface (even if they are considerably safer than the one at Chernobyl) or must they all be driven underground? These are all problems whose solution cannot be merely turned over to specialists, much less to departments with their narrowly technical and biased approach that frequently is not devoid of special interest, with their coverup and interconnectedness (the same thing applies even to many other exceedingly important problems of an ecological, economic, and social nature). I am personally convinced that nuclear power engineering is indispensable to humanity and must be developed, but only under conditions of practically complete safety, which in real terms demands that reactors be located underground. An international law is needed that would prohibit location of reactors on the surface. We must not move slowly.

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"The death of the Challenger crew and the accident at the Chernobyl Nuclear Power Station...have intensified the anxiety and issued a harsh warning that men are still just in the process of mastering those fantastic and powerful forces which they themselves have brought to life, that they are just now learning to place them at the service of progress," Mikhail Sergeyevich Gorbachev said in his speech over central television on 18 August 1986.

That was the first time in the 35 years of nuclear power engineering's development in the USSR that such an exceedingly sober assessment of peacetime atomic energy had been made. For many years, our scientists had been reporting to us the exact opposite in the press and over radio and television. Peaceful atomic energy was presented to broad segments of the public as all but a panacea, as the acme of true safety, ecological purity, and reliability. People were almost enthusiastic when they talked about the safety of nuclear power plants.

"Nuclear power plants are stars in the daytime!" M.A. Styrikovich, member of the academy, exclaimed in 1980 in the magazine OGONEK. "We are planting our entire earth with them. They are perfectly safe!"

They planted the earth with them....

"Atomic reactors are ordinary furnaces, and the operators controlling them are the stokers," was the popular explanation given to the broad public by N.M. Sinev, deputy chairman of the USSR State Committee for Use of Atomic Energy. This was a convenient position in all respects. First, it quieted public opinion; second, remuneration at nuclear power plants could be put on a par with thermal stations, and in a number of cases set even lower.

"The waste from nuclear power engineering, which is potentially very hazardous, is so compact that it can be stored at places isolated from the external environment," O. Kazachkovskiy, director of the Energy Physics Institute, wrote in PRAVDA on 25 June 1984. We should note that when the Chernobyl explosion roared, there were no places where the spent nuclear fuel could be disposed of, and the storage facility had to be built alongside the unit where the accident occurred, in the midst of fierce radiation fields, overexposing the

construction and installation workers.

"We live in the atomic age. Nuclear power stations have proven to be convenient and reliable to operate. Nuclear reactors are preparing to take over the heating of cities...," O. Kazachkovskiy wrote in that same issue of PRAVDA. A. Sheydlin, member of the academy, reacted as follows in LITERATURNAYA GAZETA to the remark that expanded construction of nuclear power plants in suburban zones could alarm the population: "There is a lot of emotion involved here. Our country's nuclear power stations are quite safe for the population of surrounding areas. There simply is no reason to be uneasy."

A. Petrosyants, chairman of the State Committee for Use of Atomic Energy, made his particular contribution to propagandizing the safety of nuclear power plants: "...nuclear power plants are altogether independent of sources of raw materials (uranium mines) thanks to the compactness of the nuclear fuel and the length of time it is used. Nuclear power plants are very promising with respect to the use of very large power generating units.... As energy producers nuclear power plants are clean sources of energy that do not increase the pollution of the environment." And he went on further: "A certain skepticism and mistrust of nuclear power plants which still exist have been caused by excessive fear of the radiation hazard for the plant's operating personnel and above all for the population living in the area where it is located.... Operation of nuclear power plants in the USSR and abroad, including the United States, England, France, Canada, Italy, Japan, and East and West Germany shows the complete safety of their operation provided the established operating patterns and the necessary rules are adhered to. What is more, there is some question as to which power plants are more harmful to the human organism and the environment— nuclear or coal-fired?..."[1]

A. Petrosyants failed to mention that thermal power plants may be fired not only with coal and petroleum (incidentally, this pollution is local and is not menacing at all), but also gas-fired, gas being produced in immense quantities in the USSR and, as is well-known, transported even to western Europe. Conversion of the thermal plants in the European part of our country to gas could completely eliminate the problem of pollution of the environment with ash and sulfur dioxide. But A. Petrosyants turned this problem upside down, devoting an entire chapter to pollution of the environment by coal-fired plants, and saying nothing about the cases of radioactive emissions from nuclear power plants which, of course, were well-known to him. This was done on behalf of the optimistic

conclusion: "The data we have given above concerning the favorable radiation situation in areas where the Novovoronezh and Beloyarsk Nuclear Power Plants are located are typical of all the nuclear power plants in the Soviet Union. That same favorable radiation situation is also typical of nuclear power plants of other countries...."

However, A. Petrosyants could not but have known that over its entire period of operation, beginning in 1964, the first double-loop unit of the Beloyarsk AES had shut down repeatedly: The uranium fuel assemblies had gone awry, operating personnel received a severe overexposure repairing them. This radioactive story lasted 15 years almost without interruption. Incidentally, at a second unit of that same plant, this one a single-cycle unit, 50 percent of the fuel assemblies of the nuclear reactor melted in 1977. The repair took about a year. Personnel of the Beloyarsk AES became overexposed rather quickly, and people had to be sent in from other nuclear power plants to do the dirty repair work. Nor could he have failed to know that in the city of Melekess, Ulyanovsk Oblast, highly radioactive waste was being pumped into deep underground wells, that English nuclear reactors at Windscale, Winfrith, and Dounreay had been discharging radioactive water into the Irish Sea ever since the fifties. A list of such cases could be extended.

Not wishing to arrive at the result prematurely, I will say only that it was A. Petrosyants who in a press conference in Moscow on 6 May 1986, commenting on the Chernobyl tragedy, uttered these words, which astounded many: "Science requires sacrifices." Words that are unforgettable.

But let us continue.

Here is an excerpt from the memoirs of V.S. Yemelyanov, corresponding member of the USSR Academy of Sciences and deputy director of the Scientific Research Institute for Energy Technology:

"Opponents of the development of nuclear power abroad and in our country sometimes win 'success' in fighting the new. The best-known such success is the ban on starting up the nuclear power station in Austria which was adopted after a noisy antinuclear campaign. Western journalists have now christened this nuclear plant the 'billion dollar mausoleum.' (At this point, it is suitable to point out, Yemelyanov omitted one detail: The population of Austria voluntarily paid off the cost of the nuclear power plant with contributions, paying money into the

treasury after the government, which had paid off the firms, mothballed the plant —G.M.) The development of nuclear power engineering has not taken place in our country without overcoming difficulties either," V.S. Yemelyanov admits. "At the end of the fifties, advocates of traditional power engineering prepared and almost pushed through a decision of the CPSU Central Committee and USSR Council of Ministers to halt construc- tion of the Novovoronezh AES and to build an ordinary TETs instead. The main line of argument was the low economic efficiency of nuclear power plants at that time. When Kurchatov learned about this, he set aside everything, went to the Kremlin, had a new conference of supervisory officials convened, and in a sharp discussion with the doubting Thomases he achieved confirmation of the previous decisions to build the nuclear power plant. One of the secretaries of the CPSU Central Com- mittee asked him at that time: 'And what will we get?' Kurchatov replied: 'Nothing! This will be an expensive experiment for about 30 years.' Yet he got what he wanted. It was not for nothing that many of us called Igor Vasilyevich the 'nuclear reactor,' the 'human tank,' and even the 'bomb.'..."[2]

It is time to say that the optimistic forecasts and assurances of the scientists were never shared by the operating personnel of nuclear power stations, that is, by those who dealt directly with peaceful atomic energy on a daily basis at their work station, not in the comfortable quiet of offices and laboratories.

During those years, information about accidents and defects at nuclear power stations was thoroughly filtered on the ministerial sieve of precaution; glasnost received only what the top people considered had to be published. I remember well a landmark event in those years—the accident at the American Three Mile Island Nuclear Power Plant on 28 March 1979, which dealt the first

serious blow to nuclear power engineering and dispelled the illusion of nuclear plant safety. At that time, I was working as department chief in the association Soyuzatomenergo of USSR Minenergo [Ministry of Power and Electrification] and I remember my own reaction and that of my colleagues to that unfortunate event. Having worked for many years on the insulation, repair, and operation of nuclear power plants, we knew to a certainty how reliable they were, and this could be stated briefly: the width of a blade, the width of a hair from an accident or disaster.... But neither I nor those who had worked previously in operating nuclear power plants had full information about that accident. The details about the events in Pennsylvania were stated only in the Information Sheet for internal consumption.

The question arises: What was the reason for making a secret of an accident the whole world knew about? After all, prompt appreciation of negative experience is a guarantee that the same thing will not recur in the future. But it was kept secret: The adverse information was only for the top leadership, while the lower levels received truncated pieces of information that did not contradict the official position on the complete safety of nuclear power plants. Sensible voices were perceived as an attack on the prestige of science. Back in 1974, in a general annual assembly of the USSR Academy of Sciences, A.P. Aleksandrov, member of the academy, said: "The charge is made against us that nuclear power is dangerous and threatens radioactive pollution of the environment.... But, comrades, what will happen if there is a nuclear war? What kind of pollution will there be then?"

Amazing logic! Don't you think so?

To be sure, 10 years later A.P. Aleksandrov was to acknowledge in a meeting of the party aktiv of USSR Minenergo (a year before Chernobyl): "God is still sparing us, comrades, in that we have not yet had a Pennsylvania. But, but...."

You cannot deny that the member of the academy had a presentiment of disaster. There were ample grounds for presentiment: The capacity in nuclear power had grown in unprecedented fashion, the hullabaloo of prestige had been inflated to the skies, and meanwhile the responsibility of nuclear power people, it might be said, was on the decline. Indeed, where was it to come from, this responsibility, when everything at the nuclear power plant, it would seem, was so simple and harmless.... In approximately those same years, there also began to be a change in the makeup of personnel operating nuclear power plants while at the same time there was a rapidly growing shortage of nuclear operators. Whereas previously those who were enthusiastic about nuclear power had mainly gone to work there, those who had a profound love for this cause, now people were pouring in at random. It was not first and foremost money that attracted, but prestige. It was as though people had everything, had earned it elsewhere, but they still had not been a nuclear power worker. And they became specialists right off the street! Make way for brothers and sisters and godparents so that they can share in the pie of management of the nuclear power industry!

Enough of that, we will be coming back to it. And now about Pennsylvania, Chernobyl's predecessor. I will quote excerpts from the American magazine NUCLEAR NEWS published on 6 April 1979:

"...On 28 March 1979, a major accident occurred in early morning in reactor unit No 2 with a capacity of 880 MW (electrical) at the Three Mile Island Nuclear Power Plant, located 20 km from the city of Harrisburg (Pennsylvania) and owned by the Metropolitan Edison Co.... Unit No 2 at Three Mile Island, as it turned out, was not equipped with the supplemental system to guarantee safety although there were such systems on some of the units at that plant....

"In the words of energy secretary Schlesinger, radioactive contamination of the locality around the plant was 'extremely limited' in its intensity and extent, and there was no basis whatsoever for the population to be uneasy. However, in the course of only 31 March and 1 April about 80,000 people left their homes out of the 200,000 persons living within a radius of 35 km of the plant. People refused to believe the representatives of the Metropolitan Edison Co., who were trying to persuade them that nothing terrible had happened. By order of the state's governor, a plan was drawn up for emergency evacuation of the population of the entire borough. Seven schools were closed in the county where the plant is located. The governor ordered evacuation of all pregnant women and children of preschool age living within a radius of 5 miles of the station and that people living within 10 miles should remain indoors. These actions were taken pursuant to an instruction of NRC chairman J. Hendrie after a leakage of radioactive gases into the atmosphere was observed. The most critical situation took shape 30-31 March and 1 April, when an immense hydrogen bubble threatening to blow up the reactor shell formed in the reactor vessel; in such a case, the entire vicinity would have been subjected to very intense radioactive contamination...."

Excerpts from the description of the accident.

"...The first signs of the accident were observed at 0400 hours, when for unknown reasons the main feedwater pumps stopped supplying water to the steam generator. All three emergency pumps had been undergoing repairs for 3 weeks, which was a very flagrant violation of nuclear plant operating rules."

"As a consequence, the steam generator could not draw off from the primary loop the heat the reactor was generating. The turbine tripped. The temperature and pressure of the reactor's primary loop rose sharply. A mixture of superheated water and steam began to dump through the safety valve into a special tank (quench tank), but after the water pressure dropped to normal, the valve did not seat, and as a consequence pressure in the quench tank also rose higher than was allowed. The emergency seal on the quench tank ruptured, and about 370 m^3 of

hot radioactive water leaked onto the floor."

"The sump pumps engaged automatically, the personnel should have immediately turned them off to keep all the radioactive water inside the containment, but this was not done. The water covered the floor in a layer several inches deep, began to evaporate, and radioactive gases reached the atmosphere along with steam, and that was one of the main reasons for the subsequent radioactive contamination of the locality."

"At the instant the safety valve opened, the system for emergency safety of the reactor cut in and inserted the control rods; the chain reaction therefore halted, and the reactor was practically shut down. The process of nuclear fission of uranium in the fuel rods ceased, but nuclear fission of fragments continued.... The safety valve remained open, the water level in the reactor vessel dropped, the temperature rose rapidly. This apparently formed a steam-water mixture which wrecked the reactor coolant pumps, and they shut down."

"As soon as the pressure fell, the system cut in for emergency cooling of the core, and the fuel assemblies began to cool. This occurred 2 minutes into the event. (Here, the situation resembles that at Chernobyl 20 seconds before the explosion. But at Chernobyl the personnel had turned off the system for emergency cooling of the core ahead of time.—G.M.)"

"The water was still evaporating from the reactor. The operators were unsuccessful in closing the apparently jammed safety valve by remote control. The water level dropped in the reactor, and one-third of the core was uncovered. The protective zirconium jackets of the fuel assemblies began to crack and crumble. Highly radioactive fission products began to leak out of the damaged heat-generating elements. The water in the primary loop became still more radioactive. The temperature in the reactor vessel exceeded 400°, and the indicators on the control panel went off the scale. The computer monitoring the temperature in the core began to display strings of question marks and continued to generate them for the next 11 hours...."

"On the night between 28 and 29 March, a gas bubble began to form in the upper part of the reactor vessel. The core had burned away to such an extent that water molecules were splitting into hydrogen and oxygen because of the chemical properties of the zirconium jacket of the rods. A bubble about 30 m3 in size, consisting mainly of hydrogen and radioactive gases— krypton, argon, xenon,

and others—began to greatly frustrate the circulation of coolant, since pressure in the reactor had risen substantially. But the main danger was that a mixture of hydrogen and oxygen could explode at any moment (which is what happened at Chernobyl— G.M.). The force of the explosion would have been equivalent to the explosion of 3 tons of TNT, which would inevitably have destroyed the reactor vessel. Another possibility was that the mixture of hydrogen and oxygen might escape from the reactor and accumulate under the dome of the containment. If it exploded there, all the radioactive fission products would have reached the atmosphere (which is what happened at Chernobyl— G.M.). The level of radiation within the containment had by that time reached 30,000 rems per hour, which exceeded the fatal dose by a factor of 600. What is more, if the bubble continued to grow, it would gradually drive all the coolant out of the reactor vessel, and then the temperature would rise to the point where the uranium would melt (which occurred at Chernobyl—G.M.)."

"On the night of 30 March, the size of the bubble decreased by 20 percent, and on 2 April it was only 1.4 m^3 in size. The technicians used a method called water degassing to finally eliminate the bubble and remove the danger of an explosion...."

"...President Carter visited the plant on 1 April. He called upon the population for 'calm and precise' observance of all the rules of an evacuation should the need for it arise."

"In a speech on 5 April devoted to energy problems, President Carter dwelled in detail on such alternative methods as the use of solar energy, the processing of bituminous shale, coal gasification, and so on, but he made no mention of nuclear energy at all, neither the splitting of the atomic nucleus nor controlled thermonuclear synthesis."

"Many senators declared that the accident could bring an 'agonizing reassessment' of the attitude toward nuclear power engineering, but, as they put it, the country would be forced to continue generating electric power at nuclear plants, since there was no other way out for the United States. The ambiguous position of the senators on this issue is vivid evidence of the difficult position in which the U.S. Government felt itself after the accident...."

Let us glance at the 35 years that have passed since the early fifties: Were Pennsylvania and Chernobyl so accidental, have accidents occurred at nuclear

plants in the United States and the USSR over those 35 years which can serve as a lesson and prevent people from a lax approach to this extremely complicated problem of the present time?

If we look at the history of the nuclear power industry's development, we see that accidents in nuclear reactors actually began immediately after their appearance.

In the United States of America

1951. Detroit. Research reactor accident. Overheating of fissionable material because the allowed temperature was exceeded. Contamination of the air with radioactive gases.

24 June 1959. Melting of some of the fuel elements as a result of a breakdown of the cooling system at the experimental power reactor at Santa Susana, California.

3 January 1961. Steam explosion in an experimental reactor near Idaho Falls, Idaho. Three people killed.

5 October 1966. Partial melt of the core because of a breakdown of the cooling system on the "Enrico Fermi" Reactor, not far from Detroit.

19 November 1971. Almost 200,000 liters of water contaminated with radioactive substances spilled into the Mississippi River from an overflowing reactor waste storage facility at Monticello, Minnesota.

28 March 1979. Core melt because of cooling loss of the reactor at the Three Mile Island Nuclear Plant. Discharge of radioactive gases into the atmosphere and of liquid radioactive waste into the Susquehanna River. Evacuation of the population from the disaster area.

7 August 1979. About 1,000 people received a dose of irradiation sixfold higher than the norm because highly enriched uranium was dumped from a plant for the production of nuclear fuel near the city of Erwin, Tennessee.

25 January 1982. Discharge of radioactive steam into the atmosphere occurred near Rochester because a steam generator pipe ruptured on the reactor of the Ginna plant.

30 January 1982. Alert at the nuclear power station near Ontario, New York. Radioactive substances leaked into the atmosphere because of a breakdown in the reactor cooling system.

28 February 1985. Critical state reached prematurely at the Samer plant, that is, an uncontrollable nuclear reaction, or runaway reactor, occurred.

19 May 1985. There was a leakage of radioactive water at the Indian Point 2 Nuclear Plant near New York, which belongs to the Consolidated Edison Co. The accident occurred because of a malfunction in a valve and caused a leakage of several hundred gallons, even outside the nuclear plant.

1986. Webbers Falls. Explosion of a tank containing radioactive gas at a uranium enrichment plant. One man killed. Eight injured.

In the Soviet Union

7 May 1966. Uncontrolled prompt-neutron reaction at the nuclear power plant with boiling-water reactor in the city of Melekess. Dosimeter operator and shift chief of the nuclear plant irradiated. Reactor shut down by dumping two bags of boric acid into it.

1964-1979. Over a 15-year period, repeated rupture (burning) of the fuel assemblies of the core of Unit 1 at the Beloyarsk AES. Operating personnel were overirradiated in repairing the core.

7 January 1974. Explosion of the reinforced-concrete gasholder which served as a holding tank for radioactive gases in Unit 1 at the Leningrad AES. No casualties.

6 February 1974. Rupture of the intermediate loop in Unit 1 at the Leningrad AES when the water boiled up and was followed by water hammer. Three were killed. Highly radioactive water was dumped into the environment together with filter powder slurry.

October 1975. Partial breakdown of the core ("local flaw in the metal") at Unit 1 of the Leningrad AES. The reactor was shut down, and for a day the nitrogen used in the emergency was blown into the atmosphere through the vent pipe. About 1.5 million curies of highly radioactive radionuclides were emitted into the environment.

1977. Meltdown of half of the fuel assemblies of the core at Unit 2 of the Beloyarsk AES. Repairs, during which personnel of the AES were overirradiated, took about a year.

31 December 1978. Unit 2 of the Beloyarsk AES destroyed by fire. The fire started when the ceiling slab of the turbine room fell on the turbine's oil reservoir. The entire control cable burned up. That eliminated control of the reactor. Eight persons received overdoses organizing the emergency flow of coolant into the reactor.

September 1982. Rupture of the central fuel assembly of Unit 1 at the Chernobyl AES because of operator errors. Emission of radioactivity into the industrial zone and city of Pripyat, and repair personnel also received an overdose repairing the "small salamander."

October 1982. Generator explosion at Unit 1 of the Armenian AES. Turbine room burned. Most of the operating personnel fled the station in panic, leaving the reactor without supervision. A team arriving by plane from the Koli Nuclear Power Plant helped the operators who had stayed on the scene to save the reactor.

27 June 1985. Accident at Unit 1 at the Balakovo Nuclear Power Plant. The safety valve blew when startup and adjustment operations were being conducted, and steam at 300° began to enter the room where people were working. Fourteen people were killed. The accident occurred because of unusual haste and nervousness following mistakes by inexperienced operating personnel.

All the accidents at nuclear power plants in the USSR went unpublicized except for the accidents in the first units at the Armenian and Chernobyl plants in 1982, which were mentioned in passing in a PRAVDA editorial, and that was after Yu.V. Andropov was elected general secretary of the CPSU Central Committee. In addition, there was an indirect mention of the accident at Unit 1 of the Leningrad Nuclear Power Plant in March 1976 in a meeting of the party aktiv of USSR Minenergo at which A.N. Kosygin, chairman of the USSR Council of Ministers, spoke. One of the things that he said at that time was that the governments of Sweden and Finland had made an inquiry with the USSR Government concerning the rise in radioactivity over their countries.

The situation in which accidents at nuclear power plants were kept secret from

the public became the norm under USSR Minister of Energy and Electrification P.S. Neporozhnyy. Accidents were concealed not only from the public and the government, but also from personnel at the country's nuclear power plants, which is particularly dangerous, since the lack of information about bad experience always threatens the unpredictable. Neporozhnyy's successor in the ministerial post, A.I. Mayorets, a man who was not altogether competent in power industry matters, especially those of the nuclear power industry, continued the tradition of silence. He had not been in the position more than 6 months when he ordered a ban on open publication in the press and radio and television broadcasting about the adverse results of the environmental impact on personnel and the general population and also on the environment of power facilities (the impact of electromagnetic fields, irradiation, and pollution of the air, water, and soil).

A.I. Mayorets made this dubious ethical position the foundation of his activity from the first months of his work in the new ministry. He operated within the framework of the system that had long been in place. It was Socrates in ancient times who said: "Every man is wise about what he knows well." Once he had himself secure, the first thing A.I. Mayorets did was to eliminate within USSR Minenergo Glavniiproyekt—the main administration that had been doing project planning and scientific research, leaving this important sector of engineering and scientific activity to get along on its own. That was not all. By cutting back on repair of power plant equipment, he increased the coefficient of utiliza- tion of installed capacity, thereby reducing the backup capacity at the country's power plants, sharply increasing the risk of a major breakdown.

Deputy Chairman of the USSR Council of Ministers

B.Ye. Shcherbina, an experienced administrator, unmercifully exacting, automatically transferred to the power industry methods of management from the gas industry, where he had been minister for a long time. Shcherbina really has a fierce bite, imposing on nuclear power plant builders his own deadlines for starting up the power-generating units, and when the deadline passed, he would accuse them of reneging on "obligations they had assumed."

I recall a conference on 20 February 1986 in the Kremlin where nuclear power plant managers and chiefs of power plant construction projects followed a kind of rule: the plant manager or project chief presenting the report would speak no more than 2 minutes, and Shcherbina, who would interrupt them, would talk for

35-40 minutes at least.

The most interesting speech was delivered by R.G. Khenokh, chief of the Construction Administration of the Zaporozhye AES, who screwed up his courage and in a heavy bass voice (a bass voice was regarded as a breach of tact in such a conference) announced that the third unit at the Zaporozhye AES would be started up no earlier than August 1986 at best (the actual startup occurred 30 December 1986) because equipment had been delivered late and the computer complex was not ready and was just then being installed. "Well, what do you think of that, what a hero!" Shcherbina exclaimed outraged. "He is setting his own deadlines!" And his voice heightened to a scream: "Who gave you the right, Comrade Khenokh, to set your own deadlines instead of those of the government?" "The deadlines are dictated by the way in which the work has to be done," the construction project chief persisted. "Cut it out! You can't fool me! The government deadline is May 1986. You will be so kind as to start it up in May!" "But delivery of the special fitting will only be completed at the end of May," Khenokh rejoined. "Make the delivery earlier!" And Shcherbina turned to Mayorets, who was sitting beside him: "Take note, Anatoliy Ivanovich, your construction project chiefs are covering themselves with the lack of equipment and are not meeting deadlines...." "We will put a stop to that, Boris Yevdokimovich," Mayorets promised. "It is hard to see how one can build a nuclear power plant and put it into operation without equipment.... After all, it is not I who delivers the equipment, but the industry through the customer," Khenokh muttered and despondently took his seat. It was after the conference against the background of the Kremlin that he told me: "This is our national tragedy. We ourselves lie and we teach our subordinates to lie. No good will come of this." I remind the reader that this conversation took place 2 months before the Chernobyl disaster.

In April 1983,1 wrote an article about creeping planning in construction of nuclear power plants and offered it to one of the central newspapers. The article was not accepted. Here is a brief quote:

"What are the reasons for the unrealistic planning in the nuclear construction sector and for the persistent failures lasting for decades? There are three of them.

"1. The incompetence of the people who plan the activation of power capacity and who manage the sector of nuclear power plant construction.

"2. The unreality and as a consequence creep of planning, caused by the incompetence of the assessments.

"3. Machine-building ministries are not ready to produce equipment for nuclear power plants in the quantity required and the requisite quality...."

The fact that incompetence is directly related both to the quality and the realism of the plan and also to the safety of nuclear plants is more than obvious, but unfortunately there have had to be repeated reminders of this. After all, many management posts in the nuclear industry are held by unqualified people.

For instance, the central headquarters of USSR Minenergo, including the minister and a number of his deputies, has been incompetent about matters specifically nuclear. The nuclear direction in power plant construction has been managed by Deputy Minister A.N. Semenov, who was appointed to this complicated job 4 years ago since by education and many years of experience he was a hydropower plant builder. (In January 1987, he was removed from supervision of construction of nuclear power plants on the basis of 1986 results, when power capacities were not activated on schedule.)

Nor are things what they should be in the department which on the eve of the disaster was supervising operation of nuclear power plants on line (known by its abbreviation—the VPO Soyuzatomenergo). Its chief was G.A. Veretennikov, who had never had a job in operation of a nuclear power plant. He did not know nuclear technology and after working for 15 years in USSR Gosplan, he decided to go over to the practical side. (In July 1986, he was expelled from the party and removed from his post.)

Even after the Chernobyl accident, in July 1986, B.Ye. Shcherbina exclaimed from the speaker's stand in an expanded collegium of USSR Minenergo, turning to the power industry people sitting in the audience: "You have been marching toward Chernobyl all these years!" If that is the case, then it should be added that the entire atmosphere in the nuclear power industry speeded up that march.

I deem it necessary to familiarize the reader with excerpts from an article by F. Olds entitled "On Two Approaches to Nuclear Power," which was published in the journal POWER ENGINEERING back in October 1979:

"While the member countries of the Organization for Economic Cooperation and Development (OECD) have been confronting numerous difficulties in carrying

out their nuclear programs, the CEMA member countries have undertaken to carry out a joint plan that envisages an increase in installed capacity of nuclear power plants by 150,000 MW by 1990 (this is more than one-third of the present capacity of all nuclear power plants on the globe)....

"The USSR Academy of Sciences—though this should have been expected—is assuring the general public that Soviet nuclear reactors are absolutely reliable and that the consequences of the accident at the Three Mile Island Nuclear Power Plant were overdramatized in the foreign press. A.P. Aleksandrov, distinguished Soviet atomic scientist, president of the Academy of Sciences, and director of the Atomic Energy Institute imeni I.V. Kurchatov, recently gave an interview to the London correspondent of the newspaper WASHINGTON STAR.... He is convinced that world petroleum and gas reserves will be depleted in between 30 and 50 years, so that nuclear power plants have to be built in all parts of the world, otherwise military conflicts will inevitably occur over possession of what is left of mineral fuel. He feels that these armed conflicts will occur only between capitalist countries, since the USSR will by that time have an abundant supply of nuclear power.

"The OECD and CEMA organizations are working in opposite directions.

"CEMA is placing principal emphasis on development of nuclear power and pays no great importance to the prospects for use of solar energy and other variants of a gradual transition to alternative sources of energy supply....

"For many years, the United States was the leader among the OECD member countries both in the field of practical use of atomic energy and also with respect to the size of appropriations for R&D. But then the situation changed rather quickly, and now development of nuclear power is not regarded in the United States as a priority task of state importance, but only as an extreme means of solving the energy problem. Principal attention in discussion of any piece of legislation that has to do with energy is devoted to environmental protection. Thus, the leading member countries of the OECD and CEMA are taking up diametrically opposed positions with respect to development of the nuclear power industry...."

The positions are, of course, not diametrically opposite, especially on matters concerning improvement of nuclear power plant safety. F. Olds is inaccurate here; both sides are paying maximum attention to this issue. But there are in fact

indubitable differences in assessments of the problem of development of nuclear power:

- excessive criticism and a patent overstatement of the danger of nuclear plants in the United States,
- in the USSR, complete absence of criticism for 3.5 decades and a clearly understated danger of nuclear power plants to personnel and to the environment.

The very pronounced conformism of our public, which has placed unquestioning belief in the academicians, is surprising. Is this why Chernobyl came down on us like a bolt from the blue and so devastated many people?

But it did not devastate everyone. Unfortunately, the conformity and gullibility are still with us. What are you going to do? It is easier to believe than to submit to sober doubt. Less trouble for one thing....

At the 41st Session of CEMA, which was held 4 November 1986 in Bucharest, the chairman of the USSR Council of Ministers, noting the absence of an alternative to nuclear power, said in particular:

"The tragedy at Chernobyl has not only not canceled the future for nuclear power in cooperation, but, on the contrary, having placed the problems of ensuring greater safety at the center of attention, is strengthening its importance as the only source of energy that guarantees reliable supply in the future.... The socialist countries are becoming still more actively involved in international cooperation in this field, taking as their point of departure the recommendations we have made in the IAEA....

What is more, we will be building nuclear heating plants, thereby saving on valuable organic fuel in short supply— gas and oil." The vigorous posing of the issue of development of nuclear power forces us to reflect again and again, to look at the Chernobyl lesson, at the causes, the nature, and consequences of the disaster which all of us, all of humanity, experienced at a nuclear power plant in the Ukrainian Polesie.

That is what we will attempt to do. Day by day, hour by hour, we will be seeing how events developed in the days and nights before and during the accident.

2

25 April 1986

On the eve of the disaster, my job was deputy chief of the Main Production Administration of USSR Minenergo for nuclear power plant construction.

In the evening of 25 April 1986, at 1650 hours (8.5 hours before the explosion) I was returning from Simferopol to Moscow in an IL-86 airplane following inspection of construction and installation work at the Crimean AES. I do not recall any presentiments or uneasiness at all. There was a strong smell of kerosene, to be sure, on takeoff and landing. During the flight, the sky was ideally clear. The only slight irritation was the unceasing rattle of the maladjusted elevator that carried the stewardesses and stewards up and down with refreshing beverages. There was a great deal of commotion in what they did, they seemed to be making extra work.

We flew over the Ukraine, which was buried in its flowering gardens. Some 7 or 8 hours would pass, and a new era would begin for that region, an era of misery and nuclear contamination. Meanwhile, I was looking down at the ground through the window. Kharkov floated by below in a bluish haze. I remember regretting that Kiev was off to one side. There, 130 km from Kiev, I had worked in the seventies as deputy chief engineer on the first power-generating unit of the Chernobyl AES and lived on Lenin Street in Pripyat, in the first residential district (which received the greatest radioactive contamination following the explosion).

The Chernobyl AES is located on the eastern side of a large region called the Belorussian-Ukrainian Polesie, on the bank of the Pripyat River, a tributary of the Dnieper. These are mainly plains areas with a relatively flat relief, with a very slight slope of the surface toward the river and its tributaries. The total length of the Pripyat to where it flows into the Dnieper is 748 km. The size of the catchment at the nuclear plant's section line is 106,000 km^2. This is the area from which the radioactivity will be going below the surface and also from which it will be washed by rain and snowmelt....

The splendid Pripyat River! Its water is brown, apparently because it flows out of Polesian peat bogs, the current is strong and fast; when you swim, it tries to

carry you away. After a swim, your skin is stretched tight, and it makes a scraping sound when you rub it with your hand. I have done a lot of swimming in that water and rowed in the academy's boats. If you stop rowing and scoop up some of the astringent brown water with your hand, your skin immediately tightens from the bog acids (which later, following explosion of the reactor and the radioactive discharge, became good coagulants—carriers of radioactive particles and fission fragments).

But let us return to a description of the locality. This is quite important. The water table, which is used here for residential water supply, lies at a depth of 10-15 meters below the level of the Pripyat River and is separated from Quaternary deposits by almost impermeable clayey marls.[3] This means that once radioactivity reaches that depth, it will be carried away by the groundwater....

In the Polesie, the population density is low; approximately 70 persons per square kilometer before construction began on the Chernobyl Nuclear Power Plant. On the eve of the disaster, there were already about 110,000 persons within a 30-km radius of the nuclear power plant, nearly half of them living in Pripyat, which is to the west of the 3-km public health zone of the power plant, and 13,000 in the rayon center of Chernobyl, which is 18 km to the southwest.

I have often recalled Pripyat, a little town where nuclear power plant people live. It was built almost from nothing while I was there. When I left for Moscow, three residential districts had already been built and occupied. A pleasant little town, nice to live in and very clean. One would often hear newcomers say: "What a lovely place Pripyat is!" Many retirees longed to come here and did come to live permanently. Sometimes they had difficulty obtaining the right from government institutions and even the courts to live in this little paradise, which combines a beautiful natural setting with felicitous blessings in town planning.

Quite recently, on 25 March 1986, I had checked progress at the fifth power-generating unit being built at the Chernobyl Nuclear Power Plant. There was still that same freshness of the intoxicatingly clean air, still the same quiet and agreeableness of what now was no longer a settlement, but a city with a population of 50,000....

Kiev and the Chernobyl Nuclear Power Plant were over to the northwest of our flight path. Memories receded, the huge cabin of the airliner became reality.

Two aisles, three rows of half-empty seats. It was like being in a huge barn. If you shouted, you would get an echo. Close at hand, the constant rumble and rattling of the elevator, rushing back and forth, so that you seem not to be flying in an airplane, but traveling in a huge half-empty tarantass over a blue cobblestone road. And the milk cans were rumbling behind in the rack.

I reached home from the Vnukovo Airport by 2100 hours. Five hours before the explosion.

That day, 25 April 1986, they were preparing to shut down the fourth power-generating unit for regular preventive maintenance.

While the unit was shut down, in accordance with a program approved by Chief Engineer N.M. Fomin, tests were to be run to completely deprive the power plant's equipment of power while the reactor's safety systems were turned off. The energy of the coasting of the turbogenerator rotor (rotation by inertia) was to be used to generate electric power. Incidentally, the performance of such an experiment had been proposed to many nuclear power plants, but because of the experiment's riskiness, they had all refused. The management of the Chernobyl plant had agreed.

What was the nature of the experiment, and why was it necessary?

The reason was that if the nuclear plant should suddenly be without power, all the machinery would, of course, stop, including the pumps pumping coolant water through the reactor core. As a consequence, there would be a meltdown of the core, which is equivalent to the worst case scenario envisaged by the design (MPA). Use of any possible sources of electric power in such cases was in fact envisaged by the experiment with the coasting of the turbogenerator rotor. After all, so long as the generator rotor is turning, electric power is being generated. It can and must be used in critical cases. The coasting regime is one of the subsystems in the MPA.

Such tests had been conducted even earlier at the Chernobyl plant and other nuclear power plants, but with the reactor's safety systems in operation. And everything had gone well. I myself have had occasion to take part in them.

Usually the programs for such operations are prepared in advance and cleared with the reactor's chief designer, the power plant's general project planner, and Gosatomenergonadzor. In these cases, the program obligatorily envisages

backup power supply while the experiment is being conducted. That is, depriving the power plant of power during the tests is only a supposition, it does not in fact occur. Assuming proper procedure for performance of the operations and additional safety measures, such tests were not prohibited at an operating nuclear power plant.

We should immediately emphasize that the tests with the coasting of the generator rotor could be conducted only after the reactor was extinguished, that is, after the point when the emergency safety (AZ) button is pressed and the control rods enter the core. In advance of that, the reactor must be in a stable controllable regime and have the regulation reactivity margin.

Several necessary clarifications for the general reader.

Put simply, the core of the RBMK4 reactor is a cylinder 14 meters in diameter and 7 meters high. The inside of that cylinder is filled with the nuclear fuel and graphite.

Holes extending the entire length of the cylinder (pipes) are uniformly distributed over the cross section of the cylinder, and the control rods which absorb neutrons move in those channels. When all the rods are down (that is, within the core), the reactor is shut down. As the rods are withdrawn, the chain reaction of nuclear fission begins, and the power of the reactor grows. The higher the rods are withdrawn, the greater the reactor's power.

When the reactor is loaded with fresh fuel, its reactivity margin (put simply—capacity for growth of neutron power) exceeds the ability of the control rods to stifle the reaction. In this case, a portion of the fuel (fuel assemblies) is withdrawn, and stationary absorbing rods (referred to as supplemental absorbers —DP's) are inserted in their place so as to help the rods that move. As the uranium is consumed, these supplemental absorbers are withdrawn and nuclear fuel is installed in their place.

But there is an unalterable rule: As the fuel is consumed, the number of control rods inserted in the core must not be less than 28-30 (since the Chernobyl accident, this number has been increased to 72), since a situation can occur at any moment in which the fuel's ability to increase the power proves to be greater than the absorbing ability of the control rods.

These 28-30 rods, which are in the zone of high effectiveness, represent in fact

the operational reactivity margin. In other words, in all stages of the reactor's operation its capacity for excursion must not exceed the ability of the control rods to shut down the reactor.

The question arises: Why did previous tests of this kind, including those at Chernobyl, occur without incident? The answer is simple: the reactor was in a stable controllable state, the entire set of safety systems remained in operation.

The program approved by N.M. Fomin, chief engineer of the Chernobyl Nuclear Power Plant, did not meet either of these requirements. The section of the program concerning safety measures was written in formal terms, no additional measures were envisaged, what is more—the program called for turning off the SAOR (emergency reactor cooling system), and that meant that during the entire period of the tests—about 4 hours—the reactor's safety would be essentially reduced. What is more, as will be evident from the discussion below, plant personnel deviated even from the program itself, creating additional conditions for an accident to occur.

Nor were the operators fully aware that the RBMK reactor possesses a series of positive reactivity effects which in certain cases come into play simultaneously, causing what is called a positive shutdown, that is, an explosion, in which the reactor's ability to accelerate far exceeds the ability of the safety systems to shut it down. This prompt power effect did in fact play its deadly role....

But let us go back to the test program. We will try to understand why it had not been cleared with the superior organizations, with those who along with the management of the nuclear power plant bore responsibility for nuclear safety not only of the plant itself, but also of the state.

In January 1986, V.P. Bryukhanov, manager of the plant, sent the program of the tests for clearance to the general designer at Gidroproyekt and to Gosatomenergonadzor. No answer came. This disturbed neither the management of the Chernobyl Nuclear Power Plant nor the operating association Soyuzatomenergo. Nor did this disturb Gidroproyekt and Gosatomenergonadzor.

At this point, it seems we can allow ourselves far-reaching conclusions: Irresponsibility in all these institutions of the state had reached such a level that they considered it possible to keep silent, not to invoke any penalties whatsoever, even though the general designer and the general client (the VPO

Soyuzatomenergo) and Gosatomenergonadzor possess such rights, and it is moreover their direct obligation. But there are specific individuals in these organizations who bear responsibility. Who are they?

In Gidroproyekt—the general designer of the Chernobyl Nuclear Power Plant—V.S. Konviz was responsible for nuclear power plant safety. He is an experienced designer of hydroplants, a candidate of engineering sciences specializing in hydraulic engineering installations. For many years (from 1972 to 1982), he was director of the nuclear power plant design sector, and since 1983 he has been responsible for nuclear power plant safety. In the seventies, when he began to design nuclear power plants, Konviz hardly had an elementary notion about what a nuclear reactor is, and he mainly hired specialists in the design of hydraulic installations to do this work. On this point, everything is presumably clear. Such a man could not foresee the possibilities of disaster contained in the program and indeed in the reactor itself.

In Soyuzatomenergo—the association of the USSR Ministry of Power and Electrification which operates nuclear power plants and is actually responsible for everything done by operating personnel—the senior official was G.A. Veretennikov, a man who has never been involved in operating a nuclear power plant. From 1970 to 1982, he worked in USSR Gosplan, where he planned deliveries of equipment for nuclear power plants. Things did not go well for various reasons, year after year only half of the equipment was delivered. Veretennikov was often sick, he had, as they say, a "bad head," the blood vessels of the brain were subject to spasms. But his inner drive to occupy a high post seems to have been strongly developed. In 1982, he filled the vacant combined job of deputy minister and chief of the association Soyuzatomenergo. It proved to be beyond his strength, the spasms of vessels in the brain began once again, fainting spells, the Kremlin hospital. One of the veterans of Glavatomenergo, Yu. Izmaylov, has remarked in this connection: "Under Veretennikov, it became almost impossible to find a nuclear expert in the main administration who was an expert on reactors and nuclear physics. At the same time, the bookkeeping department, the supply department, and the planning department grew by leaps and bounds...." In 1984, the additional post of deputy minister was eliminated, and Veretennikov became simply the chief of the association Soyuzatomenergo. His fainting spells became more frequent, and he spent a long time in the hospital.

Not long before Chernobyl, this is how Ye.S. Ivanov, chief of the production

department of Soyuzatomenergo, justified the increasingly frequent emergency situations at nuclear power plants: "Not a single nuclear power plant fully adheres to the operating regulations. This is indeed impossible. Operating experience is constantly making its own corrections and adjustments...."

It took the nuclear disaster at Chernobyl to hurl Veretennikov out of the party and out of his position as chief of Soyuzatomenergo.

At Gosatomenergonadzor, a rather sophisticated and experienced group had formed, headed by committee chairman Ye.V. Kulov, a nuclear physicist, who had worked for a long time on nuclear reactors belonging to Minsredmash. But, however strange it may seem, even Kulov paid no attention to the half-baked program for tests that had come from Chernobyl. Why? After all, the regulation on Gosatomenergonadzor, approved by Decree No 409 of the USSR Council of Ministers on 4 May 1984, provided that the committee's main task was "state supervision over observance by all ministries, departments, enterprises, organizations, institutions, and key personnel of the established rules, standards, and instructions concerning nuclear and technical safety in the design, construction, and operation of facilities in the nuclear power industry."

The committee was also given the right (to be specific, under Subparagraph g) "to invoke responsible measures, all the way to shutting down operation of facilities in the nuclear power industry, when safety rules and standards are not observed, when equipment defects are discovered, when personnel are incompetent, and also in other cases when there is a threat to the operation of these facilities...."

I remember that at one of the conferences in 1984 Ye.V. Kulov, who had just been appointed chairman of Gosatomenergonadzor, explained his duties in this way to nuclear power industry people: "Do not think that I will be working for you. Figuratively put, I am a policeman. My job is to prevent and countermand things you do wrong." Unfortunately, it was precisely as a "policeman" that Ye.V. Kulov did not act in the case of Chernobyl.

What kept him from halting the operations on generating Unit 4 at the Chernobyl Nuclear Power Plant? After all, the test program did not withstand criticism. And what had stood in the way of Gidroproyekt and Soyuzatomenergo?

No one reacted, as if by agreement. What are we dealing with here? We are

dealing with a conspiracy of silence. When there is no glasnost, then there are no lessons. Thus, there are no accidents either. Everything is safe, everything is reliable. It was not in vain that Abu Talib said: Whoever shoots a pistol at the past will be gunned down by the future. I would rephrase it for nuclear power industry people in particular: In their case, the future will strike them with a nuclear reactor explosion. A nuclear disaster.

Another detail has to be added here, one which has not been mentioned in any of the technical reports on what happened. Here is that detail: The regime with the spinning rotor of the generator and with emergency safety systems practically inoperative had been planned in advance and was not only reflected in the test program, the technical preparations had even been made. Two weeks before the experiment the MPA (maximum emergency envisaged by the design) button had been inserted into the panel of the large control board of generating Unit 4; it was wired only to the secondary power circuits, but not the monitoring and measuring instruments and the pumps. That is, the signal produced by that button was just a simulation.

Let us explain once again for the general reader: When the emergency safety system (AZ) is activated, all 211 control rods fall downward, cooling water shoots in, emergency pumps are turned on, and the diesel generators providing reliable electric power are started up. Emergency pumps supplying water from the clean condensate tanks and pumps supplying water from the bubbler pond to the reactor are also activated. That is, the safety systems are more than adequate if they are activated at the right time.

So all of these safety systems should thus have been wired to the MPA button. But unfortunately they had been disabled—since the operators were afraid of a heat shock to the reactor, that is, the inflow of cold water into the hot reactor. This poor excuse for an idea had apparently hypnotized both the management of the nuclear power plant (Bryukhanov, Fomin, and Dyatlov) and the superior organizations in Moscow. Thus, the holy of holies in nuclear technology had been violated: After all, if the maximum design emergency was envisaged by the design, this meant that it could occur at any moment. And in that case who gave anyone the right to deprive the reactor of all the safety systems prescribed by nuclear safety rules? No one had. They took it upon themselves....

But the question that arises is why the irresponsibility of Gosatomenergonadzor, Gidroproyekt, and Soyuzatomenergo did not put Bryukhanov, director of the

Chernobyl Nuclear Power Plant, and Chief Engineer Fomin on the alert? After all, work cannot be done under a program that has not been cleared. What kind of men are these, what kind of specialists? I will tell about them briefly. I met Viktor Petrovich Bryukhanov in the winter of 1971 when I arrived at the nuclear power plant's construction site in the settlement of Pripyat directly from a Moscow clinic where I had been undergoing treatment for radiation sickness. I was still not feeling well, but I could walk and decided that I would get back to normal more quickly if I was working. I signed the paper saying that I was leaving the clinic at my own wish, I got on the train, and by morning I was already in Kiev. From there, I quickly reached Pripyat in 2 hours by taxi.

I had been treated in that same Moscow Clinic No 6 where 15 years later they would bring the fatally irradiated firemen and operating personnel who were casualties in the nuclear disaster on Unit 4....

But at that time, in the early seventies, nothing yet stood on the site of the future nuclear power plant. They were digging the foundation pits for the main building. This was in a sparse young pine forest with air that is intoxicating as it is nowhere else. Sandy hillocks grown up with the low trees, bald spots of clean yellow sand against the background of dark green moss. No snow. In some places, green grass warmed by the sun. Silence and a sense of the primordial.

"Worthless land," the taxi driver said, "but ancient. Here in Chernobyl, Prince Svyatoslav chose his bride. The bride was a lively one, they say. This little town is more than 1,000 years old. And it has remained standing after all, it has not died...."

In the settlement of Pripyat, the winter day was sunny and warm. It was often that way there—like winter, but it always smelled of spring. The taxi driver stopped alongside the long barracks where the plant management and construction administration were located.

I went into the barracks. The floor gave way and creaked under my feet. I found the director's office—a tiny little room 6 m2 in area. Bryukhanov stood up to greet me, a man who was short in stature, with dark very curly hair, a face burned and wrinkled, and he smiled shyly as he shook my hand. Later, the first impression of the gentleness of his character, of his obligingness, was confirmed, but something else in him was also revealed, specifically a desire, out of a lack of knowledge of people, to surround himself with people who had a great deal of

life experience, but sometimes were not always neat and tidy workers. After all, Bryukhanov was quite young at that time—36 years old. By profession and work experience he was a turbine specialist. He had graduated from the Power Engineering Institute with distinction, he rose up the ladder at the Slavyansk GRES (a coal-fired plant), where he gave a good account of himself starting up a unit. He would not come home for days, he worked efficiently, and he knew what he was doing. And in general I later learned in working side by side with him for several years: he is a good engineer, keen-witted, and industrious. But the trouble is that he is not a nuclear power engineer. Nevertheless, a deputy minister from the Ukrainian Minenergo who was responsible for the Slavyansk GRES spotted Bryukhanov and promoted him to be the manager at Chernobyl.

Chief Engineer Mikhail Petrovich Alekseyev came to Pripyat from the Beloyarsk AES, where he worked as deputy chief engineer for the third unit, which is under construction and which at the time counted only on paper. Alekseyev had no experience in nuclear operation, and before the "Beloyarka" he had worked for 20 years at thermal stations. As it soon turned out, he was dying to go to Moscow, and that is where he went about 3 months after I began to work at the plant.... After the Chernobyl disaster, M.P. Alekseyev, deputy chairman of Gosatomenergonadzor, was issued a severe party reprimand to be entered on the record card. His chief in the Moscow job, Ye.V. Kulov, chairman of Gosatomenergonadzor, was given a still more severe penalty; he was discharged and expelled from the party. The same penalty came down on Bryukhanov.

But that happened 15 years later. And in my view the causes of it included personnel policy at the nuclear power plant. From the very first months (before Chernobyl, I had been shift chief at another nuclear power plant for many years), in building up the staff of shops and departments I proposed to Bryukhanov people with many years of experience at nuclear power plants. As a rule, Bryukhanov did not refuse outright, but he gradually brought into these positions people from thermal stations. In his opinion, experienced station operators should work at a nuclear power plant who had a good knowledge of powerful turbine systems, of power distribution equipment, and power delivery lines. By great effort, enlisting support of Glavatomenergo over Bryukhanov's head, I managed at that time to staff the reactor and special chemical shops with the necessary specialists. Bryukhanov staffed the turbine and electrical departments. At the end of 1972, N.M. Fomin and T.G. Plokhiy came to the Chernobyl plant. Bryukhanov had recommended the former for the position of chief of the

electrical shop, and the latter for the position of deputy chief of the turbine shop. Both of these men were Bryukhanov's own candidates. Fomin, an electrical engineer by experience and education, had been promoted to the Chernobyl plant from the Zaporozhye GRES (a thermal station), and before that he worked in the Poltava power system. I mention these two names because in 15 years the largest accidents at Balakovo and Chernobyl would be associated with them.

As deputy chief engineer for operations, I had a talk with Fomin: A nuclear power plant is a radioactive and extremely complicated enterprise, did he fully understand that when he left the electrical shop at the Zaporozhye GRES? Fomin has an irresistible smile that shows his white teeth. He seems to be aware of that, and he smiles both when and when it is not called for. The answer he gave me at that time was that a nuclear power plant is a prestigious and ultramodern affair. In moments of agitation, his rather pleasant and energetic baritone alternated with alto tones. He was chunky and angular, and his dark eyes had a narcotic glint. He was precise in his work, expeditious, exacting, and impulsive. Ambitious and unforgiving. One felt that inside he was always compressed in a coil ready to spring. I am telling about him in such detail because he was to become a kind of nuclear Herostratus and historical figure of a certain kind whose name would be associated with the most horrible nuclear disasters at a nuclear power plant beginning on 26 April 1986.

Taras Grigoryevich Plokhiy, by contrast, was listless, thorough, a typical phlegmatic, but meticulous, persistent, hard-working. One might say of him on the basis of first impressions: a vague and listless fellow, if it were not for his methodicalness and persistence in his work. What is more, his closeness to Bryukhanov concealed many things (they had worked together at the Slavyansk GRES), and in the reflection of that friendship he appeared more substantial and vigorous.

Bryukhanov vigorously promoted Plokhiy and Fomin to the top management of the Chernobyl Nuclear Power Plant. Plokhiy was the front-runner—he became deputy chief engineer for operations and then chief engineer. On Bryukhanov's recommendation, he was promoted to chief engineer at the Balakovo AES, which was under construction, a plant with a water-cooled and water-moderated reactor whose design he did not know, and as a consequence in June 1985 an accident occurred during startup and adjustment operations because of the negligence of operating personnel and a flagrant violation of operating rules; 14 people died, boiled alive.

They pulled the bodies out of the spaces that ringed the reactor shaft into the emergency lock and piled them up at the feet of the incompetent chief engineer, who was pale as death.

Meanwhile, at the Chernobyl plant Fomin had been moving with seven-league strides from the position of deputy chief engineer for installation and operation and replaced Plokhiy in the post of chief engineer. We should note at this point that USSR Minenergo did not support the recommendation of Fomin. V.K. Bronnikov, an experienced reactor specialist, had been proposed for that position. But Kiev did not consent to Bronnikov, referring to him as an ordinary technician (tekhnar). Fomin, they said, was a fierce and exacting manager, we want him. And Moscow gave in. Fomin was cleared in the department of the CPSU Central Committee, and the matter was decided. The price of this concession is well-known.

That would have been a good place to stop and look around and reflect on the Balakovo experience, to tighten responsibility and caution, but....

At the end of 1985, Fomin was in a car accident and broke his spine. He was paralyzed for a long time and his hopes were dashed. But the powerful organism overcame the illness, and Fomin went to work on 25 March 1986, a month before the Chernobyl explosion. I was in Pripyat at exactly that time inspecting the fifth power-generating unit, which was under construction; things were going poorly, progress was held up because project documentation and technological equipment were not in hand. I saw Fomin at a conference which we called specifically concerning Unit 5. He had failed greatly. In his entire appearance, there was some kind of constraint, the imprint of the suffering he had gone through. I shared my fears with Bryukhanov, he reassured me: "Nothing terrible, on the job he will soon get back to normal...."

We talked, Bryukhanov complained that there were many leaks at the Chernobyl plant, the fittings were not holding, the drains and air vents were leaking. The total leakage was almost constantly about 50 m^3 of radioactive water per hour. They were barely able to handle it with the evaporators. There was a great deal of radioactive sludge. He said that he was feeling extremely tired and wanted to move to another job somewhere....

He had recently returned from the 27th CPSU Congress in Moscow, where he was a delegate.

So, what happened in the fourth power-generating unit at the Chernobyl AES on the eve of the disaster?

At 0100 hours on the night of 25 April 1986, operating personnel started to reduce the power of the No 4 reactor, which was operating within nominal parameters.

At 1305 hours on that same day, the No 7 turbogenerator was taken offline. The supply of power to meet the needs of the unit itself (the four main circulating pumps, the two electric feedwater pumps, etc.) was switched to the buses of the No 8 turbogenerator, which remained in operation.

At 1400 hours, in accordance with the program of the experiment, the emergency reactor cooling system (SAOR) was turned off—one of Fomin's most flagrant and fatal mistakes. We need to emphasize once again that this had been done deliberately in order to eliminate the possibility of a heat shock when cold water reached the hot reactor from the tanks of the emergency cooling system.

After all, those 350 m3 of emergency water from the SAOR tanks, when the prompt-neutron excursion began, when the main circulating pumps failed, and the reactor was left without cooling, could possibly have saved the situation and extinguished the steam effect of reactivity, which was the most important one of all.

It is difficult at this point to figure what reasons Fomin had in those fatal hours, but only a man who absolutely did not understand the processes of neutron physics in the nuclear reactor or who at the least was extremely presumptuous could have turned off the emergency reactor cooling system, which in the critical seconds could have sharply reduced the steam content in the core and perhaps have prevented the explosion.

So, it was done, and done, as we already know, deliberately. A.S. Dyatlov, deputy chief engineer for operations, and the entire staff for management of the fourth power engineering unit also appear to have succumbed to the hypnosis of excessive self-confidence, as they acted contrary to the laws of nuclear physics. Otherwise, at least one person would have come to his senses at the moment when the SAOR was turned off and said: "Stop! What are you doing, guys?!" But no one did come to his senses, no one did cry out. The SAOR was calmly disabled, the gate valve on the water supply line to the reactor had been closed

and padlocked so that in case of necessity they could not even be opened by hand. So that they could not be foolishly opened and 350 m^3 of cold water dumped on the red-hot reactor.

Yet in case of the maximum emergency envisaged by the design, cold water would nevertheless go to the core! Here, the lesser of two evils should have been chosen: better to feed cold water to the hot reactor than to leave the red-hot core without water. After all, water from the emergency cooling system would arrive precisely when it needed to arrive, and the heat shock is in this case not commensurable to an explosion.

The psychological question is very complicated. But, of course, the conformism of the operators, who had become accustomed to think independently, carelessness, and slipshod habits had become the norm in the management staff of the nuclear power plant. There was also the lack of respect for the nuclear reactor, which was perceived by the operators as something like a samovar from Tula, just perhaps a bit more complicated. To forget the golden rule of those who work with explosives: "Just remember! Do something wrong and there is an explosion!" There was also the electrical engineering bent in the thinking; after all, the chief engineer was an electrical engineer, and what is more he had just suffered a serious accident to his spine. The oversight of the medical and public health department of the Chernobyl plant, which should be alert in monitoring the health and fitness of nuclear operators and also the plant management and send them home if necessary, is also indisputable.

And at this point we need to mention once again that the emergency cooling had been disconnected deliberately in order to avoid a heat shock to the reactor when the MPA button was pressed. Dyatlov and the operators were presumably convinced that the reactor would not let them down. It is right at this point that you begin to understand the operators did not fully comprehend the physics of the reactor and did not foresee the ultimate development of the situation. I think that the comparatively successful operation of the plant over a period of 10 years also helped to blunt people's edge. And even the serious warning from the other world—the partial meltdown of the core of Unit 1 at the Chernobyl Nuclear Power Plant in September 1982—was not taken as a lesson. Since the authorities were keeping silent, we were hearing voices from God. Information at the level of rumors, without the sobering analysis of bad experience.

But let us go on. At 1400 hours, the shutting down of the unit was halted at

request of the Kiyevenergo load dispatcher. Operation of Unit 4 continued at that time with the SAOR disconnected—a most flagrant violation of operating rules, although the formal excuse was the existence of the MPA button.

At 2310 hours (Tregub was chief of the shift at Unit 4 at that time), reduction of power was resumed.

At 2400 hours, Tregub turned the shift over to Aleksandr Akimov, and the senior engineer for management of the reactor (SIUR for short) turned the shift over to Leonid Toptunov.

A question arises at this point: What if the experiment had been conducted earlier, on Tregub's shift, would the reactor's explosion have occurred? I think not. The reactor was in a stable, controllable state. But the experiment could have ended in an explosion even on that shift if with the reactor's system for local automatic control (LAR for short) turned off Tregub's SIUR had committed the same mistake as Toptunov, and once he had committed, it tried to climb out of the "iodine pit."...

But events developed as destiny had programmed them. And the apparent reprieve which we received from the load control dispatcher of Kiyevenergo, once it had moved the tests from 1400 hours on 25 April to 0123 hours on 26 April, in fact turned out only to be a direct road to the explosion.

In accordance with the test program, the spinning of the generator rotor was to be tested at a reactor capacity of 700-1,000 MW. We should emphasize here that this coasting was to occur at the moment when the reactor was shut down, since in the maximum accident envisaged by the design the reactor's emergency safety system (AZ) based on five emergency settings falls down and smothers the device. But another disastrously dangerous road had been chosen—to continue the experiment with the reactor operating. Why this dangerous regime was chosen remains a riddle. We can only assume that Fomin wanted a pure experiment.

Here is what happened after that. We need to explain that the control rods can be controlled all at once or in sections, groups. In a number of the reactor's operating states, it is necessary to connect or disconnect the control of local groups. With one of these local systems disconnected, as envisaged by the rules for operating a nuclear reactor at low power, SIUR Leonid Toptunov was unable

to correct the imbalance that occurred in the control system (in its measuring segment) quickly enough. As a consequence, the reactor's power fell to a value below 30 MW thermal. The poisoning of the reactor with fission products had begun. That was the beginning of the end....

At this point, it is time to become acquainted with Anatoliy Stepanovich Dyatlov, deputy chief engineer for operations of the second stage of the Chernobyl Nuclear Power Plant.

Lean, with a smoothly combed dull-gray head of hair and evasive, deep-set, and lusterless eyes, Dyatlov turned up at the plant in mid-1973. Before that, he had headed a physics laboratory at one of the enterprises in the Far East and had worked on small ship propulsion reactors. He had never worked at a nuclear power plant. He did not know a power plant's heat diagrams or uranium-graphite reactors. "How are you going to do your work?" I asked him. "This is something new for you." "I will learn," he said in a somewhat forced manner, "the valves are there, the pipelines.... That is simpler than reactor physics...." He seemed to be forcing the words out with difficulty, separating them by long pauses. One sensed in him a man hard to get along with, and in our work that makes a difference.

I told Bryukhanov that Dyatlov could not be hired for the position of chief of the reactor shop. It would be difficult for him to supervise the operators not only because of his character (he clearly did not have experience in human relations), but also because of his previous work experience: his field was regular physics, he did not know nuclear technology. A day later, the order came down appointing Dyatlov deputy chief of the reactor shop. Bryukhanov had taken my opinion into account, he had appointed Dyatlov to a position lower, but the direction—the reactor shop—had remained. After my departure from Chernobyl, Bryukhanov promoted Dyatlov to chief of the reactor shop, and then he made him deputy chief engineer for operations of the nuclear power plant's second stage.

I will give descriptions of Dyatlov made by his subordinates who had worked at his side for many years.

Razim Ilgamovich Davletbayev, deputy chief of the turbine shop of Unit 4: "Dyatlov was a complicated man, hard to get along with, he did not pester personnel over trifles, he would build up his criticism (he was unforgiving), and

then he would run down several actions or errors all at once. Stubborn, tiresome, he did not keep his word...."

Viktor Grigoryevich Smagin, shift chief at Unit 4: "Dyatlov was a difficult man to get along with, someone who operated by delayed action. He was accustomed to tell his subordinates: 'I do not punish at once. I think over what a subordinate has done for at least a day, and when there is no longer any feeling of resentment in my heart, I make a decision....' He had assembled a handful of physicist supervisors from the Far East, where he had worked as chief of a physics laboratory. Orlov and Sitnikov (both killed) also came from there. And many others were friends and comrades from where he had worked before. The general tendency at the Chernobyl plant before the explosion was to thrash the operating personnel on the shifts, and to spare and give incentives to the daytime (nonoperating) personnel of the shops. There were usually more emergencies in the turbine hall, fewer in the reactor department. That accounts for the less alert attitude toward the reactor. The feeling was that it was reliable and safe...."

So, then, was Dyatlov capable of making the only correct assessment of the situation at the moment of its becoming an accident and of doing so instantaneously? I do not think so. What is more, the necessary cautiousness and sense of danger so necessary to a supervisor of nuclear operators were evidently not developed in him to a sufficient degree. On the other hand, more than enough disrespect for the operators and the operating rules....

It is precisely these qualities that were displayed in Dyatlov to their full extent when with the local automatic control turned off, SIUR Leonid Toptunov was unable to hold the reactor at a power of 1,500 MW and let it slip to 30 MW thermal.

At such a low power, intensive poisoning of the reactor with fission products (xenon and iodine) begins. It becomes very difficult or even impossible to restore the parameters. It became clear: the experiment with the coasting rotor was spoiled. All the nuclear operators understood this at once, including Leonid Toptunov and Aleksandr Akimov, the unit's shift chief. This was also understood by Anatoliy Dyatlov, deputy chief engineer for operations. Quite a dramatic situation was created. The usually dilatory Dyatlov ran from one operator's control panel to the other. His quiet hoarse voice took on an angry metallic timbre: "Dumbbells! You don't know how to do it! Incompetent failures! You are spoiling the experiment!"

One can understand him. The reactor was being poisoned, the power either had to be raised immediately or wait a day for the poisoning to be dispelled.... So waiting is what had to be done. Alas, Dyatlov, Dyatlov.... You did not learn how fast the poisoning proceeds. Stop a moment in your recklessness.... And perhaps the Chernobyl disaster will bypass humanity....

But he did not want to stop. He raged around, he rushed about the unit control room, and he wasted valuable minutes.

SIUR Leonid Toptunov and unit shift chief Akimov were deep in thought, and they had something to think about. The drop in power to such low values had occurred from the level of 1,500 MW, that is, from 50 percent of capacity. The operating reactivity margin at that level was 28 rods (that is, 28 rods were inserted in the core). Recovery of the parameters was still possible.... Time passed, the reactor was being poisoned. It was clear to Toptunov that he would hardly be able to get back up to the previous power level, and even if he did manage it, the number of rods inserted in the core would have to be sharply reduced, and in that case the reactor had to be shut down immediately. So it followed.... Toptunov made the only correct decision. "I will not take it back up!" Toptunov said firmly. Akimov supported him. Both expounded their fears to Dyatlov. "What are you yapping about, you oaf?" Dyatlov attacked Toptunov. "After a drop from 80-percent capacity, it is allowed under the rules to go back up in a day, and you dropped from 50 percent! The rules do not prohibit it. If you will not take it back up, Tregub will do it...." This was now a psychological assault: Tregub, the unit's shift chief, who had turned the shift over to Akimov and had remained to see how the test would go, was standing nearby. To be sure, we do not know whether he agreed to increase the power. But Dyatlov calculated correctly: Leonid Toptunov was intimidated by the shouting, he went against his professional instinct. He was, of course, young, only 26, inexperienced. Alas, Toptunov, Toptunov....

But he was already making the estimates: "The operating reactivity margin is 28 rods.... To offset the poisoning, another 5-7 rods belonging to the reserve group would have to be pulled out.... Perhaps I will get by.... If I disobey, they will fire me...." (Toptunov told about this in the Pripyat infirmary not long before he was sent off to Moscow.)

Leonid Toptunov began to increase the power, thereby signing a death warrant for himself and many of his comrades. The signatures of Dyatlov and Fomin

were also clearly visible beneath that symbolic warrant. The signature of Bryukhanov and many other more highly placed comrades could also be made out....

And still, to be fair, it has to be said that the death warrant was to some degree predetermined by the very design of the RBMK. All that was needed was to bring about a certain set of circumstances in which an explosion was possible. And that was done....

But we are getting ahead of ourselves. Even then, there was still time to think better of it. But Toptunov continued to increase the reactor's power. Only at 0100 hours on 26 April 1986 did he manage to stabilize it at a level of 200 MW thermal. The poisoning of the reactor with fission products had continued, power could not be raised further because of the small operating reactivity margin—by that point, it was far below what was called for by the rules. (According to the USSR report to the IAEA, the reactivity margin was 6-8 rods, according to the statement of the dying Toptunov, who looked at the printout from the "Skala" computer 7 minutes before the explosion, it was 18 rods. There is no contradiction here. The report was written on the basis of material delivered from the unit where the accident had occurred, and something could have been lost.)

For a reactor of the RBMK type, as I have already said, the reactivity margin is 30 rods. The reactor was unmanageable because Toptunov, in avoiding the "iodine pit," had withdrawn several rods from the group of the untouchable reserve. That is, the reactor's capacity for excursion now exceeded the ability of the available safety systems to shut down the device. And still it was decided to continue the tests. The inner drive for success was too strong. The hope that the reactor would not let them down and would rescue them one more time. The basic motivation in the behavior of personnel was the desire to complete the tests more quickly: "We will apply more pressure, and the job is done. Cheer up, lads!"

There were 24 minutes left before the explosion....

We will make an accounting of the most flagrant violations, both those contained in the program and also those committed in the process of preparing and conducting the experiment:

- in trying to escape the "iodine pit," they substantially reduced the operating reactivity margin, making the reactor's emergency safety system ineffective;
- they mistakenly shut off the LAR (local automatic regulation) system, which resulted in an impermissible drop in power;
- they connected to the reactor all eight main circulating pumps (GTsN) exceeding the flow rates in the emergency, which brought the temperature of the heat carrier close to the saturation point;
- intending if necessary to repeat the experiment with cutting off the power, they overrode the protection of the reactor with respect to many parameters (the shut-down signal when two turbines were disconnected, the level of water and steam pressure in the drum separators, and the heat parameters);
- they also disconnected the system for protection against the maximum accident envisaged by the design (in trying to avoid false activation of the SAOR while the tests were being conducted);
- finally, they overrode both emergency diesel generators as well as the operating and startup-standby transformers, disconnecting the unit from sources of emergency supply of power and from the power system. In trying to conduct a "pure experiment," they actually completed the chain of preconditions required for the maximum nuclear disaster.

Everything we have enumerated took on a still more ominous coloring against the background of a number of unfavorable coefficients in the neutron physics of the RBMK reactor and the defective design of the control rods in the emergency safety system.

What we are referring to is that while the height of the core was 7 meters, the absorbing portion of the rod had a length of 5 meters, and above it and below it there was a meter of empty length. The lower end of the absorbing rod, which at full insertion extends below the core, was filled with graphite. In a design like this, the part of the control rods that first enters the reactor core is the lower graphite tip, then the empty 1-meter segment enters the core, and then only after that the absorbing part. In all, Unit 4 at the Chernobyl plant has 211 control rods. According to the data in the USSR report to IAEA, 200 rods were in the extreme upper position; according to Toptunov's testimony, 193 rods were up. The simultaneous insertion of such a number of rods into the core produces in the first instance a positive flash of reactivity, since the graphite tips are the first to

enter the core (length 5 meters) and the empty sections 1 meter in length. A flash of reactivity is terrible in a stable and controllable reactor, but when adverse factors coincide, this addition can prove fatal, since an uncontrollable runaway ensues.

Were the operators aware of this, or were they in a state of blessed ignorance? I think that they knew it, in any case they had a duty to know it, SIUR Leonid Toptunov in particular. But he was a young specialist, the knowledge still had not become his flesh and blood....

And perhaps the unit's shift chief Aleksandr Akimov did not know it, since he had never worked as SIUR. He had, of course, studied the reactor, he had passed the examinations for his job, but all the fine details of the design of the control rods could have escaped the operator's awareness, since they were not directly related to a hazard. After all, it is precisely in that design that the death and horror of the Chernobyl nuclear disaster were concealed until the time came.

I also think that Bryukhanov, Fomin, and Dyatlov had a rough idea of the rod's design, not to mention the reactor's designers and developers, but it did not occur to them that a future explosion was concealed in the tip sections of the control rods, which are the foremost system for protecting a nuclear reactor. The killing was done by what should have been the protector, which is why death was not expected from that direction....

Yet reactors have to be designed so that they shut themselves down when unforeseen excursions occur. This rule is the holy of holies in designing controlled nuclear devices. And it has to be said that the watercooled and water-moderated reactor of the Novovoronezh type meets those requirements.

Here, we need yet another brief explanation. A nuclear reactor can be controlled only thanks to the proportion of delayed neutrons, which is denoted by the Greek letter (3 (beta). According to nuclear safety rules, the rate of increase of reactor power must not exceed 0.0065 (3 over a 60-second interval. If the proportion of delayed neutrons is 0.5 (3, a prompt-neutron excursion begins. Violations of the rules and overriding the reactor's safety systems, which we have talked about above, threatened a release of reactivity equal to at least 5 (3, which meant a fatal explosive excursion.

Did Bryukhanov, Fomin, Dyatlov, Akimov, and Toptunov understand this entire

chain? The first two for certain did not. The other three should theoretically have known, but as a practical matter I think they did not. Right up until his death on 11 May 1986, Akimov kept repeating while he was still able to speak a single thought that tortured him: "I did everything correctly. I do not understand why it happened that way."

All of this is also additional indication that the drills in dealing with accidents at the plant, the theoretical and practical training of personnel, had mainly been conducted within the limits of a primitive management algorithm. But how could it have reached such a point of heedlessness, of negligence? Who and at what point incorporated into the program of our destiny the possibility of a nuclear disaster in the Ukrainian Polesie? And why was the uranium-graphite reactor chosen for a facility 130 km from Kiev? Even 15 years ago, there were many people who had doubts about that.

At one point, Bryukhanov and I were driving to Kiev in a "GAZik" on summons from A.N. Makukhin, who was then UkSSR power minister. Makukhin himself was a thermal power engineer by education and experience. On the way to Kiev, Bryukhanov said: "You won't object if it takes an hour or 2 and you deliver a lecture to the minister and his deputies about nuclear power and the design of the nuclear reactor? Try to do it in terms that can be understood, since they, like me, do not understand everything about nuclear power plants...."

Aleksey Naumovich Makukhin, UkSSR power minister, behaved in a very domineering way. He spoke jerkily. I spoke about the arrangement of the Chernobyl reactor, about the way the nuclear power plant had been configured, and about the particular features of this type of nuclear power plant. I recall that Makukhin asked: "In your view, was this a good choice of reactor design or...? What I have in mind is its being so close to Kiev...." I replied that in my view a water-cooled and watermoderated reactor of the Novovoronezh type would have been more suitable for the Chernobyl nuclear power plant than the uranium-graphite design. The twoloop plant is cleaner, there is not so much piping, and the emissions are less radioactive. In short, it is safer. "Have you read the article by Dollezhal, member of the academy, in KOMMUNIST? He does not advise bringing reactors of the RBMK type into the European part of the country, but his argument is vague...." "Well, what can I say...." "Dollezhal is right, they should not be adopted. These reactors have a long operating history in Siberia, they have proven themselves there, if it can be put that way, to be on the dirty side. That is a solid argument...." "But why didn't Dollezhal show persistence in

defending his position?" Makukhin asked severely. "I do not know, Aleksey Naumovich," I spread my hands, "there were apparently forces more powerful than academy member Dollezhal." "What are the rated emissions from the Chernobyl reactor?" the minister asked, now showing interested concern. "About 4,000 curies per day." "And the Novovoronezh type?" "About 100 curies. An essential difference." "But yet the members of the academy.... The Council of Ministers has approved the use of this reactor. Anatoliy Petrovich Aleksandrov is praising this reactor as the safest and most economical. You must have exaggerated. No matter, we will adopt it.... The operators have to work it out so that our first Ukrainian reactor is cleaner and safer than the Novovoronezh design!"

In 1982, A.N. Makukhin was transferred to the central headquarters of USSR Minenergo, where he took the position of first deputy minister for operation of power plants and power systems. By decision of the party control committee of the CPSU Central Committee, because of the results of the Chernobyl disaster, on 14 August 1986 A.N. Makukhin, USSR first deputy minister for power and electrification, received a severe party reprimand "for failing to take the necessary steps to increase the operating reliability of the Chernobyl Nuclear Power Plant."

Yet then, in 1972, it was still possible to change the design of the Chernobyl reactor to the VVER design and thereby sharply reduce the likelihood of what happened in April 1986. And the UkSSR power minister would then have not been the last person to speak.

One more significant episode. In December 1979, when I was already working in Moscow, we made an inspection trip to the Chernobyl Nuclear Power Plant. Vladimir Mikhaylovich Tsibulko, who at that time was the first secretary of the Kiev Oblast Committee of the Ukrainian CP, spoke in the conference of nuclear power plant construction personnel. His burned face with traces of keloid scars (he had fought the war in tanks and had been burned in one) became a deep red, he looked out in space in front of him and spoke in the voice of a man who was not used to making objections. But paternal notes, notes of concern and fond farewell, crept into his voice: "Look, comrades, what a beautiful city Pripyat is, it is a pleasure to the eyes! You say: four power-generating units. And I will say: not enough! I would build 8 here, 12, and what is more, let all 20 be nuclear power-generating units! And then what? And a city of 100,000 will rise up. Not a city, but a fairy tale.... You have a wonderful crew of nuclear builders and

fitters that has learned to work together. Why open up another construction site, build them here...."

During one of the pauses, I put a word in and said that excessive accumulation of nuclear cores was very risky, since it reduced the state's nuclear safety not only in case of a military conflict and an attack on nuclear power stations, but also should there be the maximum nuclear disaster.... My response went unnoticed, indeed Comrade Tsibulko's recommendation was received with enthusiasm as an instruction that had to be carried out. Construction of the third stage of the Chernobyl Nuclear Power Plant began soon after that, and they undertook to design the fourth....

But 26 April 1986 was not far off, and the explosion of the nuclear reactor of Unit 4 in a single stroke lopped 4 million kw out of the country's unified power system and halted construction of the fifth unit, which was realistically supposed to go on line in 1986.

Now, let us suppose that V.M. Tsibulko's dream had come true. Had that happened, on 26 April 1986 all 12 power-generating units would have been driven out of the power system for a prolonged period. A city with a population of 100,000 would have been depopulated, and the loss to the state would have run not to 8 billion rubles, but at least 20 billion.

We should also mention that Unit 4, designed by Gidroproyekt with the explosive-prone leaktight box and bubbler pool under the nuclear reactor, evoked at one time categorical objections from the commission of experts. As chairman of that commission, I objected to that configuration and proposed that the explosive-prone component be removed from beneath the reactor.[5] But the opinion of the commission of experts was ignored. As life has demonstrated, an explosion occurred both in the reactor itself and also in the leaktight box....

3

26 April 1986

On the evening of 25 April, upon my return from the official trip to the Crimean Nuclear Power Plant, I looked over my notes, the minutes of the conferences, including the summary of a meeting of the Bureau of the Crimean Oblast Party Committee in which I had taken part.

Before the meeting of the obkom bureau, I had talked with V.V. Kurashik, head of the obkom's industrial department, and V.I. Pigarev, obkom secretary for industry. It surprised me at the time that both of them were disturbed by the same thing: Was it not hasty to build a nuclear power plant in the Crimea, in the country's health resort, could it be that there were no other places in the Soviet Union? "Yes, there are. There are many out-of-the-way and sparsely settled or altogether uninhabited areas where nuclear power plants could be built." "So why?... Who is making the decision?" "The power minister, USSR Gosplan. And the distribution of capacity over the area of the country is planned by Elektrosetproyekt on the basis of the power requirements in the particular region." "But after all, we have electric power transmission lines stretching thousands of kilometers from Siberia to the country's European part, can it be that...." "Yes, you are right." "Which means that they could be built elsewhere than in the Crimea?" "Yes, they could." "And they should be...," Pigarev smiled mirthlessly. "But we will build them," the obkom secretary said, now correcting himself in businesslike fashion. "We will be talking about that today in the bureau with full official responsibility (printsipialnost). The builders and the management have been working sluggishly, they are not meeting their targets. This situation cannot be put up with any longer." Pigarev looked at me questioningly. "Fill me in, how do matters actually stand at the construction site, so that I can speak more convincingly in the obkom bureau."

I analyzed the situation. The secretary spoke convincingly.

During the night between 25 and 26 April, all those who would be responsible for the nuclear disaster at Chernobyl were sleeping calmly. The ministers A.I. Mayorets and Ye.P. Slavskiy, and A.P. Aleksandrov, president of the USSR Academy of Sciences, and Ye.V. Kulov, chairman of Gosatomenergonadzor, as well as V.P. Bryukhanov, manager of the Chernobyl AES, and its chief engineer

N.M. Fomin. Moscow and the entire nighttime half of the globe were sleeping.

At that time, at 2400 hours, that is, 1 hour and 25 minutes before the explosion, Aleksandr Akimov's shift came on watch in the control room of Unit 4 at the Chernobyl Nuclear Power Plant. Many of those who reported for the shift would not work through to the morning. Two would be killed immediately....

So, at 0100 hours on 26 April 1986, the power of the nuclear reactor of Unit 4 was stabilized at a level of 200 MW thermal thanks to the rough pressure exerted by A.S. Dyatlov, deputy chief engineer. The poisoning of the reactor with fission products had continued. It was impossible to raise the power further, the reactivity margin was considerably less than called for by the rules, and, as I have already said above, in the words of SIUR Toptunov, it consisted of 18 rods. That count was given by the "Skala" computer 7 minutes before the AZ (emergency safety) button was pressed.

The reactor was in an uncontrollable state and was explosive-prone. This meant that pressing the AZ button at any of the instants that remained before the disaster would have caused an uncontrollable fatal excursion. There was nothing that could be brought to bear on the reactivity.

There still remained 17 minutes 40 seconds before the explosion. This is a very long time. Almost an eternity. How much it is possible to go over in one's mind during those 17 minutes 40 seconds, one's entire life could be recalled, the entire history of humanity. But unfortunately this was only a time for moving toward the explosion....

At 0107 hours, another pump was added to the six main circulating pumps that were operating on the calculation that after the experiment was completed four main circulating pumps would remain in the loop for reliable cooling of the core.

It is important to understand here that the hydraulic resistance of the core depends directly on the power of the reactor. And since the power of the reactor was low, the hydraulic resistance of the core was also low. All eight pumps were operating, and the total flow of water through the reactor increased to 60,000 m3 an hour while the normal rate is 45,000, which is a flagrant violation of the operating rules. In such a pattern of operation, the pumps could upset the flow, vibration of the piping of the loop could occur because of cavitation (the boiling up of the water with strong shock waves).

SIUR L. Toptunov, unit shift chief A. Akimov, and B. Stolyarchuk, senior engineer for management of the unit, tried manually to maintain the reactor's parameters, but they were not fully able to do this. In order to avoid the reactor shutting down under those conditions, A. Akimov, with the consent of A.S. Dyatlov, ordered that the emergency safety signals be overridden.

The question that arises is this: Is it possible to avoid a disaster in that situation? Yes, it is. All that is necessary is to categorically give up conducting the experiment, connect the emergency cooling system to the reactor, and keep electric power supply in reserve in case of a complete loss of power. Manually, by degrees, to undertake to reduce the reactor's power until it is finally shut down, but in no case pressing the AZ—emergency safety—since that would be equivalent to the explosion....

But that opportunity was not taken. The reactor's reactivity continued to fall slowly.

At 0122:30 hours (1.5 minutes before the explosion), SIUR Leonid Toptunov saw from a printout of the program for fast estimation of the reactivity margin that it represented a value demanding that the reactor be shut down immediately. That is, those same 18 rods instead of the necessary 28. For a time he hesitated. After all, there were cases when the computer was wrong. Nevertheless, Toptunov reported the situation to Akimov and Dyatlov.

It was still not too late to halt the experiment and cautiously bring down the reactor's power manually, so long as the core was intact. But advantage was not taken of that opportunity, and the tests began. All the operators except Toptunov and Akimov, who were still confused by the data from the computer, were calm and assured in their actions. Dyatlov was also calm. He strode about the large control room and urged the kids on: "Another 2 or 3 minutes, and it will all be done. Cheer up, lads!"

At 0123:04 hours, the senior turbine management engineer Igor Kershenbaum, at G.P. Metlenko's command "Oscillograph turned on!" closed the stop-throttle valves of the eighth turbine, and the spinning of the generator rotor began. The MPA (maximum design breakdown) button was pressed simultaneously. Thus, both turbogenerating units—the seventh and eighth—were disconnected. The reactor's emergency safety was overridden so that the tests could be repeated if the first attempt was unsuccessful. That constituted yet another departure from

the program, but the whole paradox was that if the actions of the operators were correct in this case, and they had not blocked the safety system, it would have cut in when the second turbine was disconnected, and the explosion would have come upon us 1.5 minutes earlier....

At that same instant, that is, at 0123:04 hours, the main circulating pumps began to fill with steam, which reduced the flow of water through the core. The heat carrier began to boil in the reactor channels. At first, the process developed slowly. Who knows, perhaps the rise of power would have been smooth thereafter, who knows....

The SIUR Leonid Toptunov first sounded the alarm. "The emergency safety needs to be activated, Aleksandr Fedorovich, we have an excursion," he told Akimov. Akimov quickly glanced at the computer printout. The process was developing slowly. Yes, slowly.... Akimov hesitated. To be sure, there had also been another warning: 18 rods instead of 28, but.... The shift chief of the unit experienced complicated feelings. After all, he had not wanted to go back up after the power dropped to 30 MW. He did not want.... He had been against it to the point of nausea, to the point of weakness in his legs. To be sure, he had not been able to oppose Dyatlov. He did not have the character. He had given in grudgingly. But when he had given in, he became confident. He increased the power of the reactor from a state that did not conform to the rules and the whole time he was waiting for a sufficiently serious new reason to press the emergency safety button. Now, it seemed, that time had come. "I am pressing the emergency safety!" Akimov shouted and reached for the red button.

At 0123:40 hours, the unit shift chief Aleksandr Akimov pressed the emergency safety button, whose signal sent into the core all the control rods that were up as well as the rods for emergency safety proper. But first to enter the core were those fatal tip sections of the rods, which add half a beta growth of reactivity. And they entered the reactor at precisely the moment when extensive steam formation had begun there. The rise in temperature of the core had the same effect. Three factors unfavorable to the core came together.

That damned 0.5 (3 was in fact the last drop that made the cup of the reactor's patience overflow.

Now, at this point Akimov and Toptunov should have waited a bit before pressing the button, asked how suitable the system for emergency cooling of the

reactor would actually be, when it had been disconnected, chained shut and sealed, at this point their urgent concern should have been the main circulating pumps, supplying cold water to the intake line, combating the cavitation, eliminating the steam pockets and thereby feeding water into the reactor and reducing the formation of steam, and probably avoiding excessive reactivity. At this point, they should have seen that the diesel generators and working transformer were turned on so as to provide electric power for the electric motors of the crucial consumers, but alas!... That command was not given before the button was pressed.

The button was pressed, and the reactor's promptneutron excursion began....

The rods started down, but stopped almost immediately. After that, knocks were heard from the direction of the central hall. Leonid Toptunov was waiting in perplexity. When Aleksandr Akimov, unit shift chief, saw that the control rods had traveled only between 2 and 2.5 meters instead of the assumed 7, he rushed to the control panel and released the clutch of the servomotors so that the rods would fall into the core by force of their own weight. But that did not happen. Apparently, the reactor's channels had become distorted, and the rods jammed....

Then the reactor was destroyed. A sizable portion of the fuel, the reactor graphite, and other structures inside the reactor were thrown outside by the explosion. But on the synchroindicators of the position of the control rods on the Unit 4 control panel, just as on the famous clock in Hiroshima, the arrows will forever be frozen in an intermediate position, showing the depth of insertion to be between 2 and 2.5 meters instead of the supposed 7, and it is in that position that they will stay buried....

The time was 0123:40 hours....

At the moment when the AZ-5 button (Class 5 emergency safety) was pressed, the dials of the synchroindicators were brightly lighted from below in a frightening flash. Even the most experienced and coolheaded operators feel pangs in their heart during such seconds. In the bowels of the core, the destruction of the reactor had already begun, but that was still not the explosion. Twenty seconds remained before the x time....

I should mention that in the control room of Unit 4 at that time were Aleksandr Akimov, unit shift chief, Leonid Toptunov, SIUR, Anatoliy Dyatlov, deputy

chief engineer for operations, Boris Stolyarchuk, senior engineer for management of the unit, Igor Kershenbaum, senior engineer of the turbine administration, Razim Davletbayev, deputy chief of the turbine shop of Unit 4, Petr Palamarchuk, chief of the laboratory of the Chernobyl startup and adjustment enterprise, Yuriy Tregub, unit shift chief who had turned the shift over to Akimov, Sergey Gazin, senior engineer of the turbine administration from the previous shift, Viktor Proskuryakov and Aleksandr Kudryavtsev, who were SIUR trainees from other shifts, as well Gennadiy Metlenko, representative of Dontekhenergo, and his two assistants, who were in adjoining rooms.

What did Akimov and Toptunov, the operators of the nuclear process, feel at the moment when the control rods became stuck along the way and the first terrible shocks were heard from the central hall? It is difficult to say, because both operators died a painful death from radiation without leaving any testimony on this point.

But one can imagine what they felt. I am familiar with the feeling operators experience in the first moment of an accident. I have been in their shoes repeatedly when I worked in operation of nuclear power plants. In the first instant, you go numb, an avalanche comcs crushing down on your chest, you experience a cold wave of involuntary fear above all at being caught unawares and at first not knowing what to do when the pointers of the recorders and indicating instruments fly in different directions, and your eyes try to follow them all at once when the cause and pattern of the emergency state are still not clear, when at the same time (again involuntarily) you are thinking somewhere deep down, at the third level, about responsibility and the consequences of what has happened. But in the very next instant there comes an unusual clarity of mind and coolheadedness. As a consequence, your actions to localize the accident are rapid and precise....

Toptunov, Dyatlov, Akimov, and Stolyarchuk were in confusion. Kershenbaum, Metlenko, and Davletbayev understood nothing about nuclear physics, but the alarm of the operators passed over to them as well.

The control rods stopped partway, they did not go down even after Akimov, unit shift chief, disconnected the couplings of the servos. Violent crashing sounds could be heard from the central hall, the floor was trembling, but this still was not the explosion....

The time was 0123:40 hours.... We will leave the unit control room of Unit 4 of the Chernobyl Nuclear Power Plant for those 20 seconds that remained before the explosion....

At that very moment, Valeriy Ivanovich Perevozchenko, chief of the reactor shop shift on Akimov's watch, entered the central hall of Unit 4 at the +50 level (an open platform near the area where the fresh fuel is weighed out). He looked at the refueling machine which was motionless against the opposite wall, at the door of the small room where the central hall operators Kurguz and Genrikh were, at the floor of the central hall, he looked at the fuel holding tanks crammed full with the spent fuel that had been dumped, at the reactor snout....

The snout is what they call a circle that is 15 meters in diameter and consists of 2,000 blocks. Taken together, these blocks constitute the upper biological shield of the reactor. Each of these blocks weighing 350 kg is perched like a hat on the head of a production channel containing a fuel assembly. Around the snout was the corrosionresistant floor made up of the ducts for biological protection, and under them the spaces carrying the steam lines from the reactor to the drum separators.

And suddenly Perevozchenko shuddered. Strong and frequent shock waves began, and the 350-kilo blocks— they had another name in the design, "assembly 11"— began to jump up and down on the heads of the channels as though 1,700 men had begun to toss up their hats. The entire surface of the snout had come to life, and it was rocking in a wild dance. The boxes for biological shielding around the reactor were shuddering and caving in. This meant that bursts of the explosive mixture had already occurred beneath them....

Barking his hands and striking painfully against the angles of the handrail, Perevozchenko hurtled down the steep and almost vertical spiral staircase to the +10 level and the transverse corridor that connected the rooms containing the main circulating pumps. Actually, he fell into a pit 40 meters deep just barely slowing himself down in flight.

With his heart booming, in a state of panic, aware that what was happening was horrible and irreparable, on legs that were becoming weak from involuntary fear, he fled leftward, to the exit onto the deaerator gallery; beyond a welcome turn 20 meters from the exit was the beginning of the 100-meter corridor, and halfway along that was the entrance to the Unit 4 control room. He hurried there to report

to Akimov about what was happening in the central hall. At the instant when Perevozchenko leaped into the connecting corridor, Valeriy Khodemchuk, a machine operator, was at the far end of the main circulating pump room. He had been following the behavior of the pumps. The pumps were vibrating severely, and Khodemcnuk set out to report this to Akimov, but at that point came the roar of the explosion.

Vladimir Shashenok, an adjuster from the Chernobyl startup and adjustment enterprise, was on duty with the instruments in a room on the +24 level located under the reactor's feedwater unit. He was taking readings from instruments during the coasting of the rotor and maintained telephone communication with the control room and the "Skala" computer complex.

What happened in the reactor? To understand that, we need to go back a bit and follow the chain of operator actions.

At 0123 hours, the parameters of the reactor were the closest to stable. Before that, Boris Stolyarchuk, senior engineer of the unit management, sharply reduced the flow of feedwater from the drum separators, which naturally resulted in a rise of water temperature where it entered the reactor.

After the stop-throttle valve had been closed, the No 8 turbogenerator disconnected, the spinning of the rotor began. Because of the reduced steam consumption from the drum separators, its pressure began to rise slightly, at a rate of 0.5 atmosphere per second. Total flow through the reactor began to drop because all eight main circulating pumps were operating off the spinning turbogenerator. It was their vibration that was observed by Valeriy Khodemchuk (there was not enough electricity, the power of the pumps decreased in proportion to the drop in generator revolutions, and the flow of water into the reactor also fell correspondingly). The drop in steam pressure on the one hand and the drop in water flow through the reactor and also the drop in the supply of feedwater to the drum separators on the other were competing factors determining the steam content in the core and consequently the reactor's power.

I should mention that the steam coefficient of reactivity (between 2 and 4 P) is the most important in uraniumgraphite reactors. The effectiveness of emergency safety was substantially reduced. The total positive reactivity in the core began in turn to increase because of the sharp reduction in the flow of cooling water through the reactor. That is, the rise in the temperature on the one hand caused

increased formation of steam and Jan the other an extremely rapid growth of the temperature and steam effects. This also served as an impetus for pressing the emergency safety button. But, and we have also spoken about that, an additional 0.5 p of reactivity was introduced when the AZ button was pressed. In 3 seconds following the pressing of the button, the reactor's power exceeded 530 MW, and the period of the excursion fell to far less than 20 seconds.

As the reactor's power grew, the hydraulic resistance of the core increased sharply, water flow dropped still more, steam was generated intensely, heat removal reached the critical point, the assemblies containing the nuclear fuel burst, there was a tumultuous boiling up of the heat carrier, which was already receiving particles of the damaged fuel, pressure rose sharply in the production channels, and they began to rupture. With the sharp rise of the pressure in the reactor, the check valves of the main circulating pumps slammed shut, and the flow of water through the core stopped altogether. The formation of steam intensified. The pressure rose at a rate of 15 atmospheres per second.

Perevozchenko, shift chief in the reactor shop, also observed the moment when large-scale rupture of the process channels began at 0123:40 hours.

Then, in the last 20 seconds before the explosion, when Perevozchenko was hurtling down from 50 meters to the + 10 level, a tumultuous steamzirconium reaction and other chemical and exothermic reactions were taking place in the core, giving off hydrogen and oxygen, that is, an explosive mixture.

At that point, there was a powerful eruption of steam— the reactor's main safety valves came on automatically. But the eruption lasted a short time, the valves were not capable of coping with such pressure and flow, and they ruptured.

At the same time, the lower water lines and the upper steam lines were torn away by the immense pressure. On the upper side, the reactor was open to the central hall and the spaces used by the drum separators, and below, it was open to the leaktight box which the designers had envisaged to localize the maximum nuclear accident. But no one had foreseen that accident the way it actually occurred, and so the leaktight box served in this case simply as an enormous container in which explosive gas began to build up.

At 0123:58 hours, the concentration of hydrogen in the detonating mixture in various spaces of the unit became explosive, and according to some witnesses

there were two and according to others three or more explosions in succession. As a matter of fact, the reactor and the building of Unit 4 were destroyed by a series of powerful explosions of the mixture of hydrogen and oxygen.

The explosions resounded at precisely that moment when the machine operator Valeriy Khodemchuk was at the far end of the main circulating pump room, and Perevozchenko, chief of the reactor shop shift, was running along the corridor of the deaerator galleries toward the control room....

Burning pieces, sparks, and flame erupted over Unit 4. These were hot chunks of nuclear fuel and graphite; some fell on the roof of the turbine hall and set it afire, since the roof had an asphalt covering.

In order to understand what quantity of radioactive substances was ejected into the atmosphere and onto the grounds of the plant by the explosion, we need to present a description of the neutron field at 1 minute 28 seconds before the explosion.

At 0122:30 hours, the "Skala" computer system produced a printout of the actual fields of energy emissions and of the positions of all the absorbing control rods. (We need to note at once that the computer spends between 7 and 10 minutes doing computations, so that it probably was showing the state of the system approximately 10 minutes before the explosion.) At the moment of the calculation, the neutron field was concave with respect to the diameter of the core, and vertically on the average it had two humps with higher energy emission in the upper part of the core.

Thus, if we are to believe the computer, in the upper third of the zone there was formed a zone of high energy emission that was like a flattened ball with a diameter of about 7 meters and a height of about 3 meters. It is in this part of the core (its weight is about 50 tons) that the prompt-neutron excursion mainly occurred; that is, it is here that the heat emission became critical, rupture occurred, melting and then also evaporation of the nuclear fuel. It is this part of the core that was ejected to a great height in the atmosphere by the explosion of the hydrogen-oxygen mixture and was carried by the wind in a northwest direction, across Belorussia and the Baltic republics beyond the borders of the USSR.

The fact that the radioactive cloud moved at an altitude between 1 and 11 km is

indirectly confirmed by airport service technician Antonov at the Sheremetovo Airport, who said that arriving planes (it is well-known that present-day jet liners fly at an altitude of about 13 km) went through decontamination for a week after the explosion at Chernobyl....

Thus, about 50 tons of nuclear fuel was vaporized and thrown into the atmosphere by the explosion in the form of finely dispersed particles of uranium dioxide, the highly radioactive radionuclides iodine-131, plutonium239, neptunium-139, cesium-137, and strontium-90, and many other radioactive isotopes with varying half-life periods. Another 70 tons or so of fuel were ejected from the peripheral areas of the core by the lateral rays of the explosion into a heap with structural debris, onto the roof of the deaerator galleries and turbine hall of Unit 4, as well as onto the grounds around the station.

Part of the fuel was ejected onto equipment and transformers of the substation, onto the busbars, the roof of the central hall of Unit 3, and the power plant's ventilation pipe.

It should be emphasized that the activity of the ejected fuel was as high as 15,000-20,000 roentgens per hour, and a powerful radiation field was immediately formed around the unit where the accident occurred, a field practically equal to the activity of the ejected fuel (the activity of a nuclear explosion). Activity decreased in proportion to the square of the distance from the heap.

It should be noted at once that the vaporized portion of fuel formed a massive reservoir of highly radioactive aerosols in the atmosphere that was particularly thick and radiating intensively in the area of the affected unit and indeed the entire power plant.

This reservoir, which filled rapidly, grew radially, and, carried by the variable wind, took the shape of an immense and sinister radioactive flower.

Approximately 50 tons of nuclear fuel and about 800 tons of reactor graphite (the entire charge of graphite amounted to 1,700 tons) remained in the reactor shaft in the shape of a funnel resembling a volcano crater. (In the days that followed, the graphite remaining in the reactor burned up entirely.) Some of the nuclear dust sifted down through the rips into the space beneath the reactor, to the floor; after all, the lower water pipes were torn away by the explosion....

In order to estimate the scale of the radioactive material ejected in terms of weight, we should mention that the atomic bomb dropped on Hiroshima weighed 4.5 tons; that is, the weight of the radioactive substances formed in the explosion was 4.5 tons.

The reactor of Unit 4 of the Chernobyl Nuclear Power Plant flung into the atmosphere 50 tons of vaporized fuel, creating an immense atmospheric reservoir of radionuclides with long half-lives (that is, 10 Hiroshima bombs without the primary factors of destruction plus 70 tons of fuel and about 700 tons of radioactive reactor graphite that came down in the area of the affected power-generating unit).

Totaling up the preliminary results, we will say that the activity in the area of the affected unit was between 1,000 and 1,500 roentgens per hour. To be sure, there were places at a distance and behind cover where the activity was considerably lower.

V.Ye. Shcherbina, deputy chairman of the USSR Council of Ministers, Yu.A. Izrael, chairman of USSR Goskomgidromet, and his deputy Yu.S. Sedunov stated at a press conference on 6 May 1986 in Moscow that radioactivity in the area of the affected unit of the Chernobyl Nuclear Power Plant was only 15 milliroentgens per hour, that is, 0.015 roentgen per hour. I think that this kind of inaccuracy is unforgivable, to put it mildly.

It is sufficient to say that in the city of Pripyat alone radioactivity in the street during the entire day of 26 April and for several days that followed was between 0.5 and 1 roentgen per hour everywhere, and prompt truthful information and organizational measures would have spared tens of thousands of people from overirradiation, but....

But let's go back a bit.

Important here are the sequence, the quantity, and the sites of the explosions of the oxyhydrogen mixture that destroyed the atomic reactor and the building of Unit 4.

Once the production channels had been ruptured and the steam and water lines torn away from them, steam, saturated with vaporized fuel, together with the products of radiolysis and of the steam-zirconium reaction (hydrogen plus oxygen), entered the central hall, the spaces of the drum separators right and left,

and the spaces of the leaktight box beneath the reactor.

Once the lower water lines, through which coolant was fed to the core, had been torn away, the nuclear reactor was altogether without water. Unfortunately, as we realized later, the operators did not understand this or did not wish to believe it, which resulted in an entire chain of wrong moves, overirradiation, and death which could have been avoided.

So—explosions.... As I have already said, they occurred first in the reactor's production channels when the excessive pressure rise began to rupture them. The lower and upper piping of the reactor met the same fate. After all, the pressure, as we recall, rose at an almost explosive rate—15 atmospheres per second—and very rapidly reached 250300 atmospheres. The working parts of the production channels and the piping were rated for a maximum of 150 atmospheres (optimum pressure in the reactor's channels is 83 atmospheres).

Once it had ruptured the channels and reached the reactor space, which was rated for a pressure of 0.8 atmosphere, the steam inflated it, and the steam explosion of the metal structures occurred first. The pipeline that existed for discharge of steam from the reactor space was calculated for the rupture of only one or two production channels, and in this case they all ruptured.

I will quote a fragment of an entry in a journal kept by one of the firemen in Moscow's Clinic No 6: "At the time of the explosion, I was right by the dispatcher station, where I was on duty. A powerful discharge of steam was suddenly heard. We paid no importance to it, since discharges of steam had occurred repeatedly while I had worked there (he is referring to the operation of the safety valves in the normal operating process of the nuclear power plant—G.M.). I intended to go off to rest, and at that point there was the explosion. I dashed to the window, after the explosion there were others that followed instantaneously...."

So—"a powerful discharge of steam...the explosion...after the explosion there were others that followed instantaneously...."

How many explosions were there? On the evidence of the fireman, at least three. Or more.

Where could the explosions have occurred? The sound from the powerful discharge of steam—that was made by the reactor's safety valves, but they

immediately ruptured. Then the steam and water pipelines ruptured. Possibly even the piping of the circulating loop in the leaktight box. Consequently, hydrogen and steam went first to the spaces containing the steam lines, the first small puffs of the oxygen-hydrogen mixture occurred which were observed by V. Perevozchenko, reactor shop shift chief, at 0123:40 hours.

Hydrogen and steam also reached the spaces of the right and left drum separators, the central hall, and the leaktight box.

It only takes a 4.2-percent concentration of hydrogen in a space to initiate the explosive reaction of hydrolysis resulting in nothing more than ordinary water.

So, explosions must have been resounding right and left in the shafts of the downcomers of the leaktight box, right and left in the spaces of the drum separators, and in the corridor of the steam header under the reactor itself. This series of explosions destroyed the spaces of the drum separators, the drum separators themselves, weighing 130 tons apiece, were moved from their fixed footings and tore away from the pipelines. Explosions in the shafts of the downcomers destroyed the right and left rooms of the main circulating pumps. One of them became the grave of Valeriy Khodemchuk.

The large explosion in the central hall must have followed after that. This explosion carried away the reinforced-concrete roof, the 50-ton crane, and the 250-ton refueling machine along with the overhead crane it was mounted on.

The explosion in the central hall would have been like a detonator for the nuclear reactor, which had been uncorked and which contained a great deal of hydrogen. Possibly the two explosions—in the central hall and in the reactor—occurred simultaneously. In any case, the most terrible and last explosion of the oxygen-hydrogen mixture occurred in the core, which had been destroyed by the internal ruptures of the production channel, part of which had melted, and part of which had been vaporized.

This was the last explosion; it hurled an immense amount of radioactivity and incandescent chunks of nuclear fuel, part of which fell on the roof of the turbine hall and deaerator galleries, setting the roof on fire.

Here is a continuation of the fireman's entry from the journal he kept in Moscow's Clinic No 6: "I saw a black fireball which soared over the roof of the turbine section of Unit 4...."

Or another entry: "In the central hall (+35.6 level—the floor, the central hall itself did not exist—G.M.), it looked like a glow or luminescence. But there was nothing there to burn, only the snout of the reactor. We decided that that glow came from the reactor...."

The firemen observed this scene both from the roof of the deaerator galleries and from the roof of the special chemical unit (the +71-meter level), where they had climbed to assess the situation from above.

The explosion in the reactor hurtled upward and swung in the air the slab of the upper biological shield, which weighed 500 tons. It crashed back down onto the reactor in the skewed and slightly inclined position, leaving the core partially uncovered both right and left.

One of the firemen climbed to the level of the floor of the central hall (+35.6) and looked into the reactor. Radiation of about 30,000 roentgens per hour plus the powerful neutron radiation was coming from the crater of the volcano. But the young firemen, though they guessed, did not have a full conception of the extent of the radiation danger threatening them. Radiation of about 20,000 roentgens per hour was also coming from the fuel and graphite they walked over for a long time on the roof of the turbine hall.

But for a time we will leave the firemen, who truly conducted themselves like heroes. They extinguished the visible flame and conquered it. But the flame of the neutron and gamma radiation, which you cannot extinguish with water, that invisible flame, was burning them, and it consumed many....

There were a few people who saw the explosions and the beginning of the disaster from outside, but at a close distance. Their accounts are very important.

At the moment of the explosion, Daniil Terentyevich Miruzhenko, age 46, was on duty in the administration Gidroelektromontazh, which was located 300 meters from Unit 4. He ran to the window when he heard the first explosions. At that point, the last terrible explosion resounded, a powerful roar like the sound when a jet fighter breaks the sound barrier, a brilliant flash of light lit up the room. The walls shook, the windows rattled, and panes flew out in many cases, and the floor trembled underfoot. That was the nuclear reactor exploding. A column of flame, sparks, and glowing chunks of everything flew into the night sky. Fragments of concrete and metal structures somersaulted in the flame of the

explosion.

"Why is it blazing up like that....," the guard thought in perplexity, fear and alarm, when he felt his heart pounding in his chest and immediately some kind of pressure and dryness throughout his body, as though he had become thin in an instant.

Then immediately after the main explosion, the roof of the turbine hall and deaerator galleries started. The melted asphalt could be seen pouring off the roof. "It's already burning....What the hell....It's already burning....," the guard whispered to himself, unable to come to his senses from the explosions and the convulsions of the floor that he could feel under his feet.

The first fire-fighting teams arrived at the unit from the fire station of the industrial area, from the window of whose duty room the firemen saw the scene of the beginning of the disaster. These were the trucks of Lieutenant Vladimir Pravik's watch. Miruzhenko rushed to the telephone and called the construction administration of the Chernobyl Nuclear Power Plant, but no one answered. The clock said 0130 hours. The duty officer was not there or was sleeping. Then the guard called Yu.N. Vypiraylo, chief of Gidroelektromontazh, but he was not at home either. He was evidently fishing. Miruzhenko waited for the morning, he did not leave his work station.

At that same time, from the opposite side of the nuclear power plant, closer to the city of Pripyat and the Moscow-Khmelnitskiy branch rail line, at a distance of 400 meters from Unit 4, Irina Petrovna Tsechelskaya, operator of a concrete-mixing unit of the structural fabrications combine of the Chernobyl Nuclear Power Plant, who was working a shift, also heard the explosions—four booms, but worked through to morning. After all, her concrete-mixing unit was supplying concrete to make fabrications for Unit 5, which was under construction and where on the night from 25 to 26 April about 270 men were working, 1,200 meters as the crow flies from Unit 4. The radiation background there was 1-2 roentgens per hour, but here and there the air was already densely saturated with shortand long-lived radionuclides and graphite ash, whose radioactivity was very high and which all these people were breathing.

When the explosions thundered, Tsechelskaya remembers, she thought involuntarily: breaking the sound barrier.... Explosion of a boiler at the PRK (startup-standby boiler plant).... Or perhaps hydrogen had gone off in the

receivers? Whatever she knew from her past experience came to her mind. But the boiler plant was standing intact, the equipment was undergoing preventive maintenance (it was warm outside).... There was no sound of a passing airplane, as one usually hears after the sonic boom. A heavy freight train rumbled past 100 meters closer to the city of Pripyat, and everything fell silent. Then slapping and cracking sounds became audible and the scream of the raging flame over the roof of the Unit 4 turbine hall. This was the keramzit and asphalt of the roof, ignited by the nuclear debris, that were burning. "They will put it out!" Tsechelskaya confidently decided, and she kept at her work.

In Tsechelskaya's concrete-mixing unit, the radiation background was 10-15 roentgens per hour.

The radiation situation was least favorable in the northwest direction from Unit 4, on the side of the Yanov Railroad Station, the overpass over the railroad from the city of Pripyat to the Chernobyl-Kiev Highway. The radioactive cloud passed there following the explosion of the reactor. The depot of Gidroelektromontazh also lay on the path of the cloud; it was from its window that the guard Miruzhenko observed the explosions and the development of events on the roof of the turbine hall. The cloud passed over the young pine forest that separated the city from the industrial area, sprinkling it abundantly with its nuclear ash. By autumn, it would turn red and always would remain a red forest fatally dangerous to anything alive. The radiation background outside, in the area of the Gidroelektromontazh depot, was about 30 roentgens per hour.

Who else could see the explosion of the Unit 4 reactor on that fatal night of 26 April 1986?

Fishermen, they seemed to replace one another practically all day and all night at the place where the drain entered the cooling pond; everyone fished when he was not on duty. The water was always warm after going through the turbines and heat-exchanging equipment, and there are plenty of bites. Also, it was spring, spawning, and the fishing was just excellent.

It is about 2 km from the fishing place to Unit 4. The radiation background there reached .5 roentgen per hour. When they heard the explosions and saw the fire, many remained there fishing until morning, while others, feeling an incomprehensible anxiety, a sudden dryness in their throat and burning in their eyes, went back to Pripyat. People had become accustomed not to pay attention

to noises like the cannonlike booms when the safety valves operated, which were like explosions, but the fire.... They would put it out. It's nothing much!

At the moment of the explosion, two fishermen were sitting on the bank of the intake channel catching minnows, which was 240 meters from Unit 4, exactly opposite the turbine hall. Every serious fisherman dreams about a pike-perch. But there is no point going for a pike-perch without a minnow, it is a waste of time. And in the springtime they particularly like to get closer to the unit, more precisely to the pumping station, they play around there, and the water teems with them. One of the fishermen was a man with no particular occupation by the last name of Pustovoyt. The other was Protasov, an equipment adjuster on a business trip from Kharkov. He liked it here very much, the intoxicating air, the excellent fishing, he even thought: "Move here to live permanently! If he could manage it, of course. The oblast in which the capital was located had a limit on newcomers, it was not so easy to arrange." They had a good catch of minnows, and they were in a good mood. A warm starry Ukrainian night. It was not like April at all, it was more like July. Unit 4, a snow-white beauty, before one's eyes. And that incongruous combination of wonderful and dazzling atomic power and the tender fish splashing in the pond evoked a sense of pleasant wonder in one's soul.

They first heard two muffled explosions within the unit, as though they were underground. A powerful steam explosion followed, perceptibly causing the ground to shudder, and only then came the explosion of the reactor with a blinding flare and fireworks from the pieces of incandescent fuel and graphite. Pieces of reinforced concrete and steel beams flew in all directions, somersaulting in the air.

The nuclear light had snatched the figures of the fishermen out of the night, but they had no idea about that. But something had exploded over there. A drum of gasoline perhaps.... They both went on catching minnows, not suspecting that they themselves, like minnows, had fallen into the powerful snare of the nuclear disaster. They just went on catching minnows, watching the turn of events with curiosity. They were watching as Pravik and Kibenok deployed their fire-fighting teams and fearlessly climbed to the level of 30 meters and rushed at the fire.

"Look! Did you see? A firefighter has even climbed on top of Unit C! (+71 meters above the ground—G.M.) He has taken his helmet off! He is giving his

all! A hero! See how hot it is." The fishermen were catching 400 roentgens apiece, as morning approached they became unrestrainably nauseous, they were both in a very bad way. Heat, fire, seemed to be burning inside their chest, irritating their eyelids, they were dizzy, like a fierce hangover. And unremitting exhausting nausea. In the course of the night, they had burned to a crisp, as though they had roasted in the sun at Sochi for a month. That is the nuclear sunburn. But they still had no idea about that.

They noticed, dawn was already breaking, that even the boys on the roof were slipping around as though they were dazed, and it was also turning them inside out. And that seemed to relieve it, just like at a party. They were in that condition when they reached the medical station and they also went on from there to the Moscow clinic....

More and more new fishermen continued to arrive at the fishing spot even on the morning of 26 April. This indicated many things: people's lightheartedness and ignorance, a long-established habit of emergency situations which they had gotten away with for many years, preventing them from being publicized. But we will come back to the fishermen later, in the morning, when the sun has risen into the nuclear heavens....

Here is the testimony of another eyewitness—G.N. Petrov, former chief of the equipment department of the installation administration Yuzhatomenergomontazh:

"On 25 April 1986, I drove in my car from Minsk via Mozyr to Pripyat. I had taken my son to Minsk to return to his Army unit for service in the GDR. My younger son, a university student, was in a construction crew in the south of Belorussia. By the evening of 26 April, he was also attempting to get through to Pripyat, but the roadblocks were already up, and they did not let him through. I approached the city of Pripyat somewhere around 0230 hours from the northwest, from the di~ection of Shipelicha. I had spotted fire over Unit 4 even when I was near Yanov Station. The ventilation stack with the red stripes across it was quite clearly illuminated by the flame. I remember well that the flame was higher than the stack. That is, it reached a height of about 170 meters above the ground. I did not want to stop by home, but decided to drive a bit closer to Unit 4 to get a better look. I approached from the direction of the construction administration and stopped perhaps 100 meters from the tower of the unit where the accident occurred. I saw in the light of the fire, which was not far away, that

the building was half-destroyed, there was no central hall or separator spaces, the drum separators had been moved from their places and gave off a reddish gleam. It was a scene to make you sick at the heart. Then I looked at the pile of rubble and the destroyed main circulating pump room. Fire trucks stood alongside the unit. An ambulance passed by on the way to the city with its light flashing.... (I want to interrupt Petrov's story to say that at the spot where he stopped his car the radiation background had reached 800-1,500 roentgens per hour, mainly from the graphite, fuel, and hovering radioactive cloud hurled up by the explosion—G.M.) I stood there for a minute, I felt an oppressive feeling of incomprehensible anxiety, numbness, my eyes took it all in and recorded it forever. And the anxiety went all through me, and I felt an involuntary fear. A sense of an invisible threat nearby. The smell was like after a strong bolt of lightning, a sour smell of smoke, my eyes began to burn, and my throat became dry. I stifled a cough. But still I lowered the window a bit in order to see better. It was after all a warm spring night. I could see quite well that the roof of the turbine hall and the roof of the deaerator galleries were burning, I could see the silhouettes of the firemen flickering in the puffs of flame and smoke, and the quivering hoses stretched upward from the fire engines. One fireman had just climbed onto the roof of Unit C, up to +70 level, was apparently observing the reactor and coordinating the actions of his fellows on the roof of the turbine room. They were 30 meters below him.... Now, a bit later, it was clear to me that he was the first of all humanity to climb up there to that unattainable height. Even at Hiroshima the people were not so close to the nuclear explosion, that bomb had exploded at an altitude of 700 meters. But here, it was close quarters, right next to the explosion.... After all, under him was the crater of a nuclear volcano and 30,000 roentgens per hour.... But I did not know that at the time. I started the car and went home, to the fifth residential district in the city of Pripyat. My family was asleep when I entered the house. It was about 0300 hours. They woke up and said that they had heard explosions, but they did not know what it was. An excited neighbor lady soon ran in, her husband had already been to the unit. She told us about the accident and suggested that we drink a bottle of vodka to decontaminate the organism. We drank the bottle in good cheer, with jokes, and lay down to sleep...."

This is a suitable place to mention to the reader that it was stated at many press conferences that immediately before the explosion the reactor had been reliably shut down, the rods had been inserted in the core.

But, as we have already said, the effectiveness of the emergency safety was for

all practical purposes nullified because of the flagrant violations of the operating rules. After the AZ button was pressed, the control rods, as has already been stated, entered only about 2.5 meters into the core instead of the assumed 7, and they did not smother the reaction, but on the contrary assisted the prompt-neutron excursion. Nothing was said at a single press conference about this most flagrant mistake of the system's designers, which ultimately served as the main cause of the nuclear disaster.

So, the core was destroyed.

Let us go back to the Unit 4 control room. It is 0123:58. SIUR Leonid Toptunov and unit shift chief Akimov were standing near the left reactor side of the control panel. Alongside them were Tregub, unit shift chief from the previous watch, and two young trainees who just recently had taken their examinations for SIUR. They had come out at night in order to see how their pal Lenya Toptunov would do his job and to learn. Aleksandr Kudryavtsev and Viktor Proskuryakov were also there. After the AZ button was pressed, the lamps lighting the synchroindicators from below lit up and gave the impression that they had become red hot. Akimov rushed to the switch to turn off the servodrives, pressed it, but the rods did not go down and became stuck in that partway position forever.

"I don't understand anything!" Akimov shouted tensely.

With an expression of bewilderment on his face, which had grown pale, Toptunov also pressed one after the other the buttons to call up a flow of water.... The MTK (display of the reactor channels) was lit—water flow was at zero, which meant: the reactor had no water, the margin preventing a crisis in heat removal had been exceeded....

The thunder from the central hall indicated that the crisis in heat removal had occurred and the channels were rupturing.

"I do not understand anything! What kind of devilry is this?! We did everything correctly...," Akimov cried out once again.

Anatoliy Dyatlov, tall and pale, with his gray head of hair combed back smoothly, who was deputy chief engineer, came over to the left side of the control panel, which was for the reactor. Stereotypical bewilderment on his face: "We did everything right.... It cannot be.... We did everything...."

Boris Stolyarchuk, senior engineer of the unit management, was at control panel P, in the central part of the control room, where the feedwater and deaerator unit were controlled. He made reconnections on the deaerator-feedwater lines of the plant, regulated the flow of feedwater into the drum separators. He was also distraught and also convinced that his actions had been entirely correct. Sharp blows to the nerves were coming from the bowels of the unit's building, a desire welled up to do something to prevent that threatening rumble, but he did not know what to do, since he did not understand the nature of what was happening.

At panel T, where the turbogenerating units were controlled (the right side of the control panel), were Igor Kershenbaum, senior engineer of the turbine management, and Sergey Gazin, who had turned the shift over to him and stayed to see how everything would go. It was Igor Kershenbaum who had performed all the operations to shut off turbogenerating unit No 8 and to put the turbogenerator in the condition of the spinning generator rotor. He had done his job in accordance with the approved program and on instructions from Akimov, unit shift chief, and he considered his actions correct. When he saw the confusion of Akimov, Toptunov, and Dyatlov, he became anxious. But he had work to do, he was never particularly disturbed. Along with Metenko, he watched the tachometer to follow the rotations of the spinning rotor. Everything seemed to be going normally. Razim Ilgamovich Davletbayev, deputy chief of the unit for the turbine shop, was right there at the turbine control panel as the man in charge....

To the left, at the reactor control panel...it was evident on the channel display: no water!

"What the devil?!" Akimov thought in both agitation and confusion. "But eight main circulating pumps are operating!" At this point, he looked at the amperemeters indicating the load. The arrows had slumped to zero. "They have failed!..." Something collapsed inside him, but only for an instant. He regained his poise. "We have to feed water...."

At that point, there were terrible blows from right and left and below and immediately thereafter—the shattering force of the all-encompassing explosion. It seemed that everything all over and everywhere was collapsing; the shock wave, with milk-white dust and the hot moisture of radioactive steam, with stifling pressure invaded the control room of Unit 4, which now was no more. Just as in an earthquake, the walls and floor buckled, there was a sifting of

material from the ceiling. The tinkle of the glass of the windows in the corridor of the deaerator galleries, the lights went out, only three emergency bulbs set up on a storage battery were still burning, the crackling and lightning bursts of short circuits—the explosion ripped out all of the electrical wiring, the power cables, and the monitoring cables....

Dyatlov issued a command in a heartrending voice that carried over the rumbling and the noise: "Cooling with emergency speed!" But this was not so much a command as a terror-stricken scream.... The hissing of steam, the eagle scream of hot water pouring in from somewhere. The mouth, the nose, the eyes, and ears were crammed with floury dust, dryness in the mouth, and utter atrophy of consciousness and will. The unexpected bolt of lightning had taken away all the senses—pain, fear, the sense of heavy guilt, and irreparable grief But it would all come, although not immediately. And fearlessness and the courage of despair were the first to return to these people. But it would be a long time yet, almost to the very point of death, before the saving and lulling lies, the myths, and the legends engendered by a dim-witted, even half-crazed mind would be conquered in some of them.

"This is it!..." the thought flashed through Dyatlov in a panic. "The explosive mixture has been detonated.... Where?... Seemingly in the emergency tank of the SUZ (safety control system—G.M.)." This version, engendered in the shocked brain of Anatoliy Dyatlov, was to wander for a long time yet in people's minds, was to console the hemorrhaging consciousness, the paralyzed and sometimes convulsively quivering will, came all the way to Moscow, and it was believed right up until 29 April; it was the basis for many actions that were sometimes fatal to people's lives. But why? Well, because that was the easiest approach. It contained both a justification and a salvation for those who were responsible from the bottom to the top. Especially those who by some miracle had been left intact in the radioactive belly of the explosion. They needed strength, and a conscience that was at least partly quieted gave it to them. After all, ahead of them was the entire night, the unendurable night of death which they had nevertheless conquered....

"What is happening?! What is this?!" Aleksandr Akimov shouted when the dusty fog had dispersed just a bit, the rumbling had quieted down, and the hissing of the radioactive steam and noise of the pouring water remained the main sounds of the nuclear giant that was expiring, and those sounds were not loud.

Aleksandr Akimov, a strapping and strong 35-year-old lad with a broad rosy-cheeked face, wearing glasses, with a dark wavy head of hair, powdered now with radioactive dust, rushed around without knowing what to do: "Sabotage?! It can't be! We did everything right...."

SIUR Leonid Toptunov—young, plump, flushed, with a little mustache, out of the institute just 3 years—was confused, pale, he had the impression that there would be another blow, but he did not know which side it should come from.

Perevozchenko ran into the control room out of breath.

Breathing fitfully, pale, all covered with dust and abrasions, he cried to Akimov, "Aleksandr Fedorovich! Out there...." He waved his hand upward, in the direction of the central hall. "Something terrible there.... The reactor snout is collapsing.... The blocks of assembly 11 are jumping around as though they were alive.... And these...explosions.... Have you heard them? What is that?"

At that instant, a silence muffled in cotton prevailed in the unit, broken only by the unfamiliar, soul-piercing, unknown hissing of steam and the sound of running water. There was a ringing in the ears from that silence which had ensued after the volcanic and deafening crashes of the calamity. There was an acrid smell in the air. Like the odor of ozone, only very sharp. A tickle in the throat....

Boris Stolyarchuk, senior engineer of the unit management, pale, looked at Akimov and Dyatlov with a kind of searching and helpless expression.

"Take it easy!" Akimov said. "We have done everything correctly...." And to Perevozchenko: "Run up, Valer, see what is going on there...."

At that instant, the door from the turbine hall was flung open. Vyacheslav Brazhnik, senior turbine machine operator, rushed in covered with soot. "Fire in the turbine hall!" he shouted shrilly, adding something incomprehensible and then leaped back toward the fire and the raging radiation.

Razim Davletbayev and Petr Palamarchuk, supervisor of the group from the Chernobyl startup and adjustment enterprise, rushed after him to the turbine hall. He had come out at night to record the vibration characteristics of generator 8 together with his coworkers from the Kharkov Turbine Plant. Akimov and Dyatlov sped to the open door. What they saw was horrible, something

inconceivable. There was burning at several places at levels 12 and 0, glowing blocks of graphite and hunks of fuel were scattered over the yellow plasticized rubber, and there was a new smoking flame burning around them. Fragments of the roof were heaped up on turbine 7. A blue-gray smoke was rising up from the heat. Fumes, black ash coming down in puffballs, hot oil gushing from a broken pipe, the break in the roof, and a panel of the roof slab swinging over the chasm of the turbine hall and just about ready to come crashing down. A powerful stream of boiling water from a broken fitting was striking the wall of the condensate box. A thick black column of radioactive graphite dust was sifting down from the break in the roof, spreading further at level 12 and coming down, and descending to cover people and equipment....

Akimov rushed to the telephone: "Zero two! Quickly!... Yes, yes! Fire in the turbine hall!... The roof, too!... Yes, yes!... Already left?! You're great!... Quickly!..."

Lieutenant Pravik's team was already swinging their trucks around near the walls of the turbine hall, they had already begun....

Dyatlov ran out of the unit control room and with resounding steps, as though he were wearing football shoes, sliding on the broken glass that made a soulwrenching gritting and grinding sound, he ran into the backup control room, which was right next to the staircase-elevator well. He pressed the AZ-5 button and turned the key to shut off power to the servodrives. Late. Why? The reactor had been destroyed.... But Anatoliy Stepanovich Dyatlov figured otherwise: The reactor was intact, the safety control system tank had ruptured in the central hall. The reactor was intact.... The reactor was intact....

The windows in the backup control room were broken, the glass made a slippery screaching sound under the feet, and there was a strong smell of ozone. Dyatlov looked out the window, stuck his head outside. Nighttime. The din and screaming of the fire raging up above. In the reddish reflection from the fire, he could see a horrible heap of structural fragments, girders, concrete, and brick. Something was scattered around the unit on the asphalt. Very thickly. Something black.... But he could not take it in that this was graphite from the reactor. Just as in the turbine room. There as well his eyes had seen the glowing chunks of graphite and fuel. But his mind would not accept the horrible implication of what he had seen.

He went back to the control room. In his soul, there now rose up the resilient will to act, responding to the emergency, to do something immediate, miraculous, to save the situation, and then everything would crash into an abyss of hopelessness and apathy. Dyatlov went back to the control room and listened to the others. Petr Palamarchuk was trying in vain to contact Room 604, where his subordinate Volodya Shashenok was with his instruments. No contact. By that time, Palamarchuk had already managed to run around turbogenerating unit 8, had dropped down to level 0, had found the men from Kharkov in the mobile laboratory installed on a Mercedes-Benz truck, and had insisted that they leave the unit immediately. As a matter of fact, the two of them had already managed to descend to the heap around the reactor and had received a lethal dose. Akimov managed to ring up all the chiefs of shops and departments and call for help. He made an urgent call to the electrical people. There was a fire in the turbine hall, hydrogen had to be removed from generator 8, power supply had to be restored to crucial consumers....

"The main circulating pumps are down!" he shouted through the receiver to Aleksandr Lelechenko, deputy chief of the electrical shop. "I cannot start a single pump! The reactor is without water! Help out quickly!"

They could not contact the dosimetrist. The switchboard had been chopped away. Only the outside telephones were working. They all felt the radiation inside them. But how much? What background? They did not know.... There were no instruments in the control room. Nor were there any "rose petal" breathing masks. Nor was there any potassium iodide. It would not be a bad idea for them all to take a tablet now. It made no difference....

No contact with the dosimetry panel.

"Petr, you go," Akimov begged Palamarchuk, "run to Kolya Gorbachenko, find out why he is silent...."

"I have to go to Shashenok, I have to go to Shashenok.... Something is wrong there.... He is also silent...."

"Get Gorbachenko and you both go to Shashenok."

Akimov switched to something else: "A report had to be made to Bryukhanov, to Fomin.... Had to.... Oh, how much had to be done.... The reactor without water.... The rods of the safety control system had stuck partway.... His mind was

confused, it was oppressed...yes, it was oppressed by shame.... A wave now burning hot, now icy, seered his heart as soon as his feverish mind tried to get the full truth of what had happened through to him. Ah, that hellish shock...the shock of becoming aware of the greatest responsibility. The full weight of it came down on him like a mountain. Something had to be done. They were all waiting on him.... Proskuryakov and Kudryavtsev, the SIUR trainees, were idly conversing nearby. The rods were jammed.... But if they were lowered from the central hall by hand? An idea....

"Proskuryakov, Kudryavtsev...." In Akimov's tone of voice there was an imploring note, although he had every right to issue orders. Everyone who was in the control room at the moment of the accident had come under his direct authority. But he implored them: "Lads, you have to go quickly to the central hall...to turn the handles...the emergency safety rods have to be lowered by hand. Nothing works from here...."

Proskuryakov and Kudryavtsev set off. They set off, my dear good lads. Young they were, so young and not to blame for anything. They set off to their death.

Valeriy Perevozchenko, it seems, was the first to realize the full horror of what had happened. He had seen the beginning of the disaster. He had already become convinced of the irreversibility, of the horrible truth of the destruction. In the central hall, he had seen such.... After what he had seen, the reactor could not exist. It simply did not exist. And if it did not exist, that meant.... People had to be rescued. He had to save the lads under him. He was responsible for their lives with his own. That is how Valeriy Ivanovich Perevozchenko, chief of the reactor shop shift, defined his responsibility during those minutes. And the first thing that he did was to go off to find Valera Khodemchuk....

Testimony of Nikolay Feodosyevich Gorbachenko, duty officer of the dosimetry department on Akimov's shift:

"At the moment of the explosion and afterward, I was at the dosimetry panel. There were several shudders with terrible force. I thought: everything, the roof. But I saw that I was alive, I was standing on my feet. Another comrade, my assistant Pshenichnikov, quite a young lad, was there with me at the dosimetry panel. I opened the door to the corridor of the deaerator galleries, clouds of white dust and steam were coming from there. There was the characteristic smell of steam. There were still flashes of discharges. Short circuits. The panels of Unit 4

were immediately extinguished on the dosimetry panel. No readings. I did not know what was happening in the unit, what the radiation situation was. The emergency signal system was working on the panels of Unit 3 (we had a single panel for the entire stage of construction). All the instruments had gone off scale. I pushed the toggle switch for the unit control room, but the switchboard had no power. No communication with Akimov. I reported by the outside telephone to Samoylenko, chief of the shift in the dosimetry department; he was at the control panel of the first stage. He in turn called Krasnozhon and Kaplun, the senior man in the radiation safety department. I tried to determine the radiation situation in the room where I was and in the corridor outside the door. I had only the DRGZ radiometer rated for 1,000 microroentgens per second. It went off scale. I had another instrument with a scale that went up to 1,000 roentgens, but when I turned it on, as luck would have it, it burned out. There were no others. Then, I went over to the unit control room and reported the situation to Akimov. Everywhere it was off scale at 1,000 microroentgens per second. Probably about 4 roentgens per hour. If that was so, then we could work about 5 hours. Depending, of course, on the conditions of the emergency situation. Akimov said I should go around the unit and determine the dosimetric situation. I went up to the level +27 through the staircase-elevator well, but I went no further. The instrument was off scale everywhere. Petya Palamarchuk came, and he and I went to Room 604 to look for Volodya Shashenok...."

And at that time, there were several fires in the turbine hall, at level 0. There was a break in the roof, glowing chunks of fuel and graphite had fallen on the floor and on the equipment, a piece of the concrete roof had broken an oil line, the oil was burning. It had also broken the pressure valve on the feed pump, and the boiling radioactive water was gushing out. The turbine oil tank and hydrogen in the generator might explode at any moment. Action had to be taken.

But for a time let us leave the turbine hall, where the operators, not sparing their lives, displayed miracles of heroism and did not allow the fire to spread to the other units. That was quite a feat. Equal to what the firemen did.

At that point, the SIUR trainees Proskuryakov and Kudryavtsev, executing Akimov's order, ran out into the corridor of the deaerator galleries and as usual turned right, toward the elevator in the VSRO unit, but they saw that the shaft had been destroyed, the elevator, twisted by an unknown force, was hanging from fragments of structural elements. Then they went back to the staircase and elevator well. There was an acrid smell of ozone— just like after a thunderstorm,

but still stronger. They kept on sneezing. And they also felt some force around them. But they started to climb up....

Perevozchenko, after he had warned Akimov and Dyatlov, rushed into the corridor of the deaerator galleries after them, intending to go look for his subordinates, who could have been in the rubble. The very first thing he did was to run to the broken windows and look out. There was an extremely strong smell as of freshness, like the air after a thunderstorm, but many times stronger. It was nighttime in the yard outside. Red reflections from the burning roof of the turbine hall in the low nighttime sky. When there was no wind, the air usually had no smell. But at this point, Perevozchenko felt as it were the pressure of the unseen rays that were running all through him. He was seized by some inner panic fear coming from the death of his organism. But his anxiety for his comrades was uppermost. He stuck his head quite far out and looked to the right. He realized that the reactor unit was destroyed. Where the walls of the main circulating pump room had been, he saw in the darkness a heap of broken structural elements, pipe, and equipment. Up above...? He raised his head. The spaces of the drum separators were not there either. That meant an explosion in the central hall. He could see fires that had started there. A great many of them.... "Ah, no safety equipment.... There isn't anything...," he thought with annoyance, filling his lungs fully with the air containing radionuclides. There was a fire burning his lungs. That first oppressiveness passed, Perevozchenko felt an inner heat in his chest, in his face, throughout his entire being. As though he had completely burned up from within. It is burning! It is burning! "What have we done?! Children will die.... In the central hall where the explosion was, the operators Kurguz and Genrikh.... In the rooms of the main circulating pumps, Valera Khodemchuk.... In the room of the control and measurement station underneath the reactor's feedwater unit was Volodya Shashenok.... Which way should he run, who should he look for first?"

First, the radiation situation had to be clarified. Perevozchenko, sliding on fragments of glass, ran to the room where the radiation safety panel was, to Gorbachenko.

The dosimetrist was pale, but collected.

"What background, Kolya?" Perevozchenko asked. His face was already burning with a brown fire.

"Well, you see.... They are off scale on a range of 1,000 microroentgens per second, the panels for Unit 4 have burned out...." Gorbachenko smiled guiltily. "We will assume that it is 5 roentgens per hour. But it seems that it could be more...."

"You mean you couldn't even get instruments?"

"Well, here is an instrument rated for 1,000 roentgens, but it burned up. The second one is locked up in the locker. Krasnozhon has the key. I just looked, that locker is in the rubble. You can't get near it. I am going now with Palamarchuk to look for Shashenok. He didn't respond from Room 604...."

Perevozchenko left the dosimetry panel and ran to the main circulating pump room, where Valera Khodemchuk had remained before the explosion. That was the closest.

Petya Palamarchuk, chief of the laboratory of the Chernobyl startup and adjustment enterprise, ran from the unit control room toward the dosimetry panel. The reader will recall that he and his subordinates were recording the characteristics and parameters of various systems while the rotor was spinning. It was now clear that Shashenok had remained silent in Room 604, which was the most dangerous place—in the monolithic reactor unit where the calamity had just struck. What had happened to him? This was a key room. The signal lines from the main operating system went down there to the recorders. If a disk ruptured.... Steam at 300°, superheated water. He did not answer the telephone. Uninterrupted whistling in the receiver. Probably the receiver had been thrown off the hook. Communication with him had been excellent 5 minutes before the explosion.

Palamarchuk and Gorbachenko ran to the staircaseelevator well. "I am going for Khodemchuk!" Perevozchenko shouted to them as they disappeared downward from the corridor of the deaerator galleries into the monolithic part of the destroyed reactor department. Fuel and reactor graphite were scattered everywhere there.

Palamarchuk and Gorbachenko ran up the stairs to level 24. At level 10, Perevozchenko ran along the short corridor toward the destroyed main circulating pump room....

At that time, the young SIUR trainees Kudryavtsev and Proskuryakov were

getting closer, working through the rubble, to level 36, which is where the reactor hall was. Up above, amplified by the echo of the empty elevator shaft, they could hear the scream of the flames, the shouts of the firemen, which were coming from the roof of the turbine hall and from somewhere quite close, apparently from the reactor snout.

"Is it also burning there...?" the lads wondered fleetingly.

At level 36, everything was destroyed. The trainees went over the heaps and piles of structural members to the large room of the ventilation center, which was now separated from the reactor hall by the destroyed castin-place wall. It was quite evident that the central hall had been burst by the explosion like a big bubble and the upper part had torn away, and the wall was left sagging, the reinforcing iron protruding in radial tatters. At some places, concrete was sifting down, and the naked network of reinforcing steel was visible. The lads stood there for a short time, shaken, recognizing with difficulty spaces that previously had been so familiar. An unusual joy that was inexplicable in such distress swept through them even though their chests burned terribly when they breathed, they had an ache in their temples, their eyelids burned as though hydrochloric acid were being dripped on them.

They went along the corridor to the entrance to the central hall. The corridor was narrow, obstructed by broken structural elements and glass. Overhead the nighttime sky in the red reflections of the fire, in the air there was smoke, cinders, acrid and suffocating, and above all that the feeling of the presence of some kind of other force in the air that was pulsating and dense and burning. That was the powerful nuclear radiation ionizing the air, and it was now perceived as a new and frightening environment that was unsuitable for life.

Without respirators and protective clothing, they went to the entrance to the central hall and, passing by three doors that were flung open, they entered the former reactor hall, which was obstructed by twisted rubble and smoldering fragments. They saw the fire hoses dangling on the reactor side. Water was pouring out of them. But there were no longer any people. The firemen had left there a few minutes before, losing consciousness and their last strength.

Proskuryakov and Kudryavtsev were at the nucleus of an atomic explosion. But where was the reactor?

The round slab of the upper biological shield, with fragments of the thin stainless steel pipes (the KTsTK system) sticking out in all directions, lay at an angle on the reactor shaft. The reinforcing steel of the demolished walls was dangling shapelessly on all sides. This meant that the explosion had hurtled the slab upward and it had fallen back down in a slanted position onto the reactor. A red and blue fire was coming from the throat of the demolished reactor with an intense howling. There clearly was a good draft—a direct flow of air all the way through. The faces of the trainees were struck by the nuclear heat with radioactivity of 30,000 roentgens per hour. They involuntarily covered their faces with their hands, as though they were sheltering themselves from the sun. It was quite clear that there were no control rods at all, carried away by the explosion. There was no point now in going down into the core. Simply no reason at all....

Proskuryakov and Kudryavtsev, fixing everything firmly in their minds that they had seen, remained near the reactor about a minute. This was enough for them to receive a fatal dose of radiation (they both died in horrible pain at Clinic No 6 in Moscow).

With a feeling of profound oppression and an inner sense of panic, that replaced the nuclear excitement, they took the same way back to level 10, entered the unit control room and reported the situation to Akimov and Dyatlov. Their faces and hands were reddish brown (nuclear sunburn). Their skin was the same color even under their clothing, which was not discovered until they reached the medical station.

"There is no central hall," Proskuryakov said. "Everything was carried away by the explosion. It is open to the sky. There is a fire from the reactor...."

"You didn't get it right, guys...," Dyatlov said in a muffled tone, drawing out his words. "There was something burning on the floor, and you thought it was the reactor. It seems that an explosion of the oxygen hydrogen mixture in the emergency tank has carried away the roof. Not surprising: 110 m3 is quite a bit so that...it could have carried away not only the roof, but the entire unit.... The reactor has to be saved. It is intact.... Water has to be fed into the core."

That is how the legend got started: The reactor is intact, the tank containing emergency water of the safety control system exploded, water had to be supplied to the reactor.

The legend was reported to Bryukhanov and Fomin. From there, it went on to Moscow. All of this generated a great deal of unnecessary, superfluous, and harmful effort that compounded the situation at the nuclear power plant and increased the number of deaths.

After taking a look at the central hall, Genrikh and Kurguz had been waiting for Perevozchenko to give the assignment for the entire shift. Approximately 4 minutes before the explosion of the reactor, Genrikh said to Kurguz that he was tired and was going to take a little nap. He went into a small neighboring room, approximately 6 m2 in area, with no windows. There was a cot in there. He closed the door and lay down.

Kurguz sat at the desk and made an entry in the log. Three open doors separated him from the central hall. When the nuclear reactor exploded, highly radioactive steam and fuel poured into the room where Kurguz was sitting. In that fiery hell, he rushed to the door. He closed it. He shouted to Genrikh: "There is a big fire! A big fire!" Genrikh jumped off the cot, rushed to open his door, but on the other side of the door there was a smell of such an intolerable heat that he no longer wanted to try, he instinctively lay down on the plasticized rubber floor, it was cooler there, and shouted to Kurguz: "Tolya, lie down! It is cooler down low!"

"At least there it was possible to breathe. It didn't burn the lungs so much," Genrikh recalled later.

They waited about 3 minutes. The heat began to recede (the sky had opened up overhead). Then they went into the corridor. Kurguz's skin was burned on his face and hands. It was hanging off in loose pieces. His face and hands were bleeding badly.

They did not set off toward the staircase-elevator well, the direction from which the trainees Proskuryakov and Kudryavtsev would soon be coming, but in the opposite direction—toward the "clean" staircase, and they went down to level 10. If they had met the trainees, then they surely would have turned them back and saved their lives. But they missed each other.

Along the way to the unit control room at level 12, Genrikh and Kurguz were joined by Simekonov and Simonenko, operators of the gas loop. Together, they headed for the Unit 4 control room. Kurguz was in a very bad way. He was bleeding. It was difficult to assist him. The skin under his clothing had also

blown up into blisters. Any touch caused the victim intolerable pain. From somewhere, he gathered more strength to go under his own power.... Genrikh was not so badly burned—he was saved by the little windowless room. But both had taken 600 roentgens apiece.... They were already going along the corridor of the deaerator galleries when Dyatlov came out of the unit control room. He rushed up to them: "Off to the medical station at once!"

It was 450 meters along the corridor of the deaerator galleries to the medical station, which was in the Unit 1 administrative building.

"Can you make it there, Tolya?" they asked the young Kurguz. "I do not know.... No, for sure.... My whole body aches.... Everything hurts...."

And they did right not to start out. The medical station in the first stage was closed. Nor was there a physician's assistant in the medical station of the second stage. That was how self-confident Comrade Bryukhanov was. Everything was safe. The conception of the recent era in practice. They called for the "ambulance" to come to the ABK [office-shelter building(?)] of the second stage, they went down to level 0, they broke out a window that had miraculously not broken and went outside through the window....

Dyatlov ran to the Unit 3 control room. He ordered Bagdasarov to shut down the reactor. On returning to the Unit 4 control room, he gave the order to Akimov: "Call the daytime personnel of the shops once again. Everyone to the unit where the accident occurred! Above all, the electrical people, Lelechenko. The hydrogen has to be removed from the electrolyzer on generator 8. They are the only ones who do that. Get at it! I will take a turn around the unit...." Dyatlov left the control room.

Davletbayev ran several times from the turbine hall to the unit control room and reported the situation. It was full of various people. The dosimetrist Samoylenko had measured Davletbayev with an instrument: "You are off scale, Razim, in all the ranges! Change clothes at once!" As luck would have it, the set of safety equipment of the turbine hall was locked up. They sent Brazhnik, who had an athletic build, to break it open with a crowbar.

Akimov ordered SIUR Stolyarchuk and the machine operator Busygin to turn on the emergency feedwater pumps in order to supply water to the reactor.

"Aleksandr Fedorovich!" Davletbayev shouted. "The equipment has no power!

We have to get the electricians working at once, there is no power at the distribution boxes.... I do not know what they will do. The cables were torn away. Everywhere there are lightning flashes from short circuits. Ultraviolet light at 0 beside the feedwater pumps. First, the TVSK lights up (piece of fuel—G.M.), then there is an arc from a short circuit...." "Lelechenko is on the way with his fine lads!"

Davletbayev again plunged into the fiery hell of the turbine hall. At level 0, Tormozin had driven wooden plugs into the holes in the oil line. Just to be smart, he had sat on the oil line and received a contact burn on the buttocks. Davletbayev rushed to the heap around turbine 7, but he could not get through. There was oil on the plasticized rubber. Very slippery. They turned on the sprinkler system. The turbine was covered with watery fog. They shut off the oil pump from the control panel.

There was a telephone booth alongside the seventh unit from which the turbine operators kept calling the unit control room. Opposite the booth, on the other side of the window, was the fifth transformer, on which there was a piece of fuel they did not know about. Perchuk, Vershinin, Brazhnik, Novik...received a fatal dose there.

At that point, Gennadiy Petrovich Metlenko, supervisor of the unsuccessful electrical experiment, was idly conversing at that time in the unit control room. Akimov at length noticed him: "Be a friend, go to the turbine room, help them to turn the valves. Everything is without power. By hand, it takes at least 4 hours to open or close each one. The diameters are immense...." The small and frail man with the lean face and the sharp nose, the representative of Dontekhenergo, ran off to the turbine hall.

Tragedy was taking place there at the level 0. A turbine oil line had been severed by a falling girder. The hot oil had gushed out and caught fire from pieces of the glowing nuclear fuel. The machine operator Vershinin put out the fire and rushed to help his coworkers so as to prevent the oil tank from exploding. Brazhnik, Perchuk, and Tormozin were sprinkling other places the fire was coming from. Highly radioactive fuel and reactor graphite fell through the break in the roof. They were scattered everywhere. The smell of burning, the radiation, the highly ionized air, the black nuclear dust from the burning graphite, and from the asphalt roof that was burning up above. A piece of a girder from the roof had broken the connection on one of the emergency feed pumps. It had to be

disconnected from the deaerators. It took at least 4 hours to turn the valves by hand. Valves also had to be turned by hand to prepare another pump to be aligned with the reactor. The radiation fields at level 0 of the turbine hall were between 500 and 15,000 roentgens per hour. They sent Metlenko back to the control room: "Go away! Don't get involved!"

Together with the electricians on Akimov's shift, Davletbayev managed to replace the hydrogen in the generator with nitrogen so as to avert an explosion. They poured the oil from the oil tanks of the affected turbine into the emergency tanks outside the power-generating unit. They poured water over the oil tanks.... The turbine operators performed an outstanding feat on that fatal night of 26 April 1986. Had they not done what they did, the fire would have burned the entire turbine hall from within, the roof would have crashed down, the fire would have spread to the other units, and this would have resulted in the destruction of all four reactors. It is difficult to imagine the consequences....

When Telyatnikov's firemen, once they had extinguished the fire on the roof, turned up in the turbine hall at 0500 hours, everything had already been done there.... A second emergency feedwater pump had been prepared and aligned with the reactor that no longer existed. Akimov and Dyatlov had assumed that the water would go to the reactor, but it could not go there for the simple reason that all the lines in the series had been torn away by the explosion, and the water from the second APEN went to the space underneath the reactor, where a great deal of damaged nuclear fuel was scattered. Mixing with the fuel, the highly radioactive water went to the lower levels of the deaerator galleries, soaking the betweenfloors that carried the cables and distribution boxes, causing short circuits and threatening loss of power supply to the power-generating units still in operation. After all, all of the Chernobyl power plant's powergenerating units are along the deaerator galleries, which carries the main cable lines, which are interconnected. At 0500 hours, Davletbayev, Busygin, Korneyev, Brazhnik, Tormozin, Vershinin, Novik, and Perchuk had vomited several times and felt very bad. They were sent off to the medical station. Davletbayev, Tormozin, Busygin, and Korneyev will survive. They absorbed 350 roentgens. Brazhnik, Perchuk, Vershinin, and Novik received 1,000 or more rads each. They would die a painful death in Moscow....

But let us go back to the beginning of the accident. We will go with Valeriy Ivanovich Perevozchenko on his road to death. He was after all looking for Khodemchuk, he wanted to save all his subordinates. This man did not know of

fear. Courage and duty led him into the fiery hell. At that time, Palamarchuk and Gorbachenko had risen by the staircaseelevator well through the rubble to Room 604, where the monitoring and measuring instruments were and where Volodya Shashenok had become silent. What had happened to him...? If he was alive....

Following a series of terrible explosions in the unit, it was now relatively quiet, only the din and noise of the flame of the burning roof of the turbine hall, the piercing shouts of people putting out the fire, the straining howl of the destroyed nuclear reactor in which the graphite was burning, could be heard through the gaps. All of that was like a distant background, but up close was the babbling brook or downpour of radioactive water running somewhere, above, below, you could not figure it out, some kind of tired residual hissing of radioactive steam and air.... The air was thickened, unfamiliar. The highly ionized gas, the harsh odor of ozone, the burning in the throat and lungs, the strained cough, and the sharp cutting pain in the eyes.

They ran without respirators, in complete darkness, feeling their way along with flashlights, which every operator always carried. And Perevozchenko ran over the short transverse corridor at level 10 to the main circulating pump room where Valera Khodemchuk had remained, and he stood still in amazement. The room was not there. Above was the sky, reflections of the flame raging over the turbine hall, but directly in front of him—large fragments, a heap of a mixture of structural elements, mutilated equipment, and pipelines.

In the heap, there was also a very large amount of reactor graphite and fuel, which was radiating at least 10,000 roentgens per hour. Perevozchenko, who was stupefied, led the way with the light of his flashlight through all of that debris. He was straining to listen, trying to catch a man's weak voice or groan. He had to find Valera and save him. He had to save him. And Genrikh and Kurguz were also up above.... Up where the explosion had been.... He would also save them.... He had to.... Those were his people, his subordinates.... He would not leave them....

And time passed. Every second, every minute more was fatal here. The body of the reactor shop shift chief was absorbing more and more roentgens, the nuclear sunburn was becoming darker and darker in the darkness of the night. And it was not just his face and hands which were burned, but his entire body under his clothing. It was burning...burning, burning.... It was burning inside....

"Valera!" Perevozchenko shouted with all his strength. "Valera! Give a cry; I am here!" He headed straight for the rubble, he climbed over fragments, searching thoroughly through the cracks in the destroyed structural elements, burning his hand on pieces of fuel and graphite which he would desperately seize upon in the darkness. Straining his eari, trying to catch the slightest moan or rustle, but in vain. As he went on searching, his body rubbing up against protruding hooks of reinforcing steel and the sharp places where concrete blocks were chipped, and he squeezed through into Room 304, but there was no one there.

Valera had been on duty at the far side.... That was where his station was....

And Perevozchenko made his way there over the rubble, to the far end, and he searched there. But everything was empty.

"Valera!" Perevozchenko shouted, throwing his hands up and shrugging his shoulders. "Dear Valera!" Tears of helplessness and grief poured down his swollen cheeks that had been burned to blackness by the radiation. "But what is this?! Khodemchuk! Respond!"

But the only response was that the reflections of the fire, which was raging in the nighttime sky over the roof of the turbine hall, illuminated Perevozchenko's face and the piercing voices of the firemen, which were like the desperate cries of wounded birds. There was also a battle against death up there, and the people there were receiving death inside themselves.

Becoming weak from the nuclear fatigue that had attacked him, Perevozchenko climbed back over the rubble, picked his way, swaying, to the stairway-elevator well and began to climb up to level 36, to the central hall. After all, that is where Kurguz and Genrikh would have died in the nuclear hell and fire.

He did not know that Anatoliy Kurguz and Oleg Genrikh, intensely irradiated and scalded by the radioactive steam, had already climbed down by the hypothetically clean staircase to level 10 and had been sent off to the medical station.

Perevozchenko retraced the path of the trainees Kudryavtsev and Proskuryakov, first went into the little operators' room, they were not there, then he went to the central hall and received an additional attack of radiation from the reactor in which the fire was droning.

Perevozchenko, who was an experienced physicist, knew that the reactor was no longer there, that it had turned into a gigantic nuclear volcano, that it would not be put out with water, since the piping below had been ripped away from the reactor by the explosion, that Akimov, Toptunov, and the boys were in the turbine hall starting up the feedwater pumps in order to supply water to the reactor, that they would die in vain. After all, you could not get water here.... All the people had to be led out of the unit. That was the most correct thing to do. People had to be saved.

Perevozchenko went down, he was continuously vomiting and nauseous and would lose consciousness for instants, he would fall down, but he came to himself, again stood up and kept on going on and on.

When he came into the unit control room, he told Akimov:

"The reactor is destroyed, Sasha.... The people have to be led out of the unit...."

"The reactor is intact! We are supplying water to it!" Akimov said heatedly. "We did everything correctly.... Go to the medical station, Valera, you're in a bad way.... You have become confused, I assure you.... It is not the reactor, it is the buildings and structures that are burning. They will put out the fire...."

At the very time when Perevozchenko was looking for Khodemchuk buried in the rubble, Petr Palamarchuk and the 'dosimetrist Nikolay Gorbachenko, climbing over the rubble and debris with difficulty to level 24 of the reactor unit, finally got through to the monitoring and measuring instrument room where Vladimir Shashenok had been at the moment of the explosion. Palamarchuk and Gorbachenko found their comrade in the debris of Room 604, pinned by a fallen beam, badly burned by the steam and hot water. Later, it was discovered in the medical station that his spine was broken, his ribs were broken, but at that point...he had to be rescued.

Just before the explosion, when pressure in the loop was rising at a rate of 15 atmospheres per second, the pipes and recorders in that room tore loose and released radioactive steam and superheated water, something fell from above, and Shashenok lost consciousness. The entire surface of his skin had received deep thermal and radiation burns. The lads freed their comrade from under the rubble, Palamarchuk, trying not to cause him new sufferings, loaded him onto his back with Gorbachenko's help and carried him to level 10, making his way

with difficulty over the heaps of concrete and pipes. From there, taking turns with Gorbachenko, they went along the corridor of the deaerator galleries, approximately 450 meters, to the medical station at the ABK of Unit 1. The medical station proved to be nailed shut. They called for emergency medical aid. In 10 minutes, the physician's assistant Sasha Skachok came, and they took Shashenok off to the medical unit. Then the pediatrician Belokon came in his ambulance and stayed on duty here until morning, until he also had to be carried off to the medical unit.

Palamarchuk and Gorbachenko had also become intensely irradiated as they were carrying their comrade, and they were soon sent to the medical unit. Gorbachenko had before that managed to go around the unit as well, measuring the gamma background, he had been in the turbine hall, and he had gone around the unit where gear was kept. But actually it was all in vain. With an instrument whose scale went only to 3.6 roentgens, he could not measure the raging radiation fields, and therefore he could not properly warn his comrades.

At 0230 hours, Bryukhanov, the plant's manager, arrived in the Unit 4 control room. His appearance was powdergray, he was confused, almost beside himself. "What happened?" he asked Akimov in a constrained voice.

In the Unit 4 control room, the radioactivity of the air at that time was about 3-5 roentgens per hour, but in some places it came from the ruins and was therefore higher.

Akimov reported that there had been a serious radiation accident, but the reactor, in his opinion, was intact, that the fire in the turbine room was in the stage of being extinguished, Major Telyatnikov's firemen were putting out the fire on the roof, that the second emergency feedwater pump was being readied for operation and would soon be connected. Lelechenko and his people merely had to supply the power. The transformer had been disconnected from the unit for protection against short circuits.

"You say there has been a serious radiation accident, but if the reactor is intact.... What is the activity now in the unit?"

"Gorbaehenko's radiometer shows 1,000 microroentgens per second...."

"Well, that is not much," Bryukhanov said, feeling a bit easier.

"That is what I think, too," Akimov confirmed excitedly.

"Can I report to Moscow that the reactor is intact?"

"Yes, you can," Akimov responded confidently.

Bryukhanov went off to his office in ABK-1 and from there at 0300 hours he called Vladimir Vasilyevich Maryin, deputy secretary for the nuclear power industry of the CPSU Central Committee, at home....

By that time, Solovyev (the name has been altered— G.M.), the nuclear plant's civil defense chief, arrived at the unit where the accident occurred. He had a radiometer with a scale that went to 250 roentgens. That was at least something. Passing along the deaerator galleries to the turbine hall and to the rubble, he realized that the situation was extremely grave. A radiometer that read up to 250 roentgens went off the scale at various places in the unit and rubble.

Solovyev reported the situation to Bryukhanov.

"Your instrument is broken," Bryukhanov said. "There can be no such fields. Do you understand what it's all about? You figure out your instrument or throw it on the dust heap...."

"The instrument is correct," Solovyev said.

At 0430 hours, Chief Engineer Fomin arrived at the unit control room. People had been looking for him for a long time. For some reason, he had not picked up the telephone at home, his wife muttered something indistinct. Someone said that he had been fishing, and that was why he had not come to the telephone. People knew something....

"Report the situation!"

Akimov made his report. He enumerated in detail the sequence of the procedures performed before the explosion.

"We did everything correctly, Nikolay Maksimovich. I have no complaints against the personnel on the shift. At the moment when the AZ-5 button was pressed, the reactivity margin was 18 rods of the safety system. The devastation was caused by an explosion of the 110-m3 tank for the emergency water of the

emergency system in the central hall, at the +71-meter level...."

"The reactor is intact?" Fomin asked in a beautiful mellow bass voice.

"The reactor is intact!" Akimov firmly replied.

"Supply water to the reactor continuously!"

"An emergency feedwater pump is now in operation from the deaerators to the reactor."

Fomin moved away. Within himself, he would first rush about like a poisoned animal, then he would collapse into a bottomless chasm, mentally issuing a panicky cry: "The end! The end!"—then he would suddenly assume iron confidence: "We will see it through!"

But he did not see it through. This man was the first to break in the face of the monstrous responsibility which only now took on its leaden weight and flattened his entire being, which was weak and essentially maintained on arrogance and vanity....

Having ordered Akimov at 0200 hours to feed water into the reactor, Anatoliy Dyatlov, deputy chief engineer for operations, had left the unit control room and gone outside accompanied by the dosimetrist, descending by the stairway and elevator well. All of the asphalt around was strewn with blocks of reactor graphite, pieces of structural elements and fuel. The air was thick and pulsating. That was the way the ionized and highly radioactive plasma felt.

"Radioactivity?" Dyatlov asked the dosimetrist.

"Off the scale, Anatoliy Stepanovich...." Stifled coughing sounds! "Damn! My throat is dry.... Off the scale at 1,000 microroentgens per second...."

"Numbskulls! Your instruments are not worth a damn! You are wasting your time!"

"But who would think there would be such fields?!" the dosimetrist suddenly became indignant. "In the locker, there is a radiometer with a scale that goes to 10,000 roentgens, but it is locked up. Krasnozhon has the key. I went to the locker to see, but I could not get through. It is blocked off. But there is radiation,

I swear it. I feel it without an instrument...."

"Turkeys! Numbskulls! Keeping an instrument in the locker? Blockhead! Measure with your nose!"

"I have already been measuring it that way, Anatoliy Stepanovich...," the dosimetrist said.

"If you would only.... After all, I am also measuring it, you son of a bitch. But I am not supposed to. That is your job.... Get it?!"

They approached all the way to the pile of rubble. It rose up like a mountain on a slant right from the ground all the way to the separator rooms....

"Incredible!" Dyatlov explained. "What have we done! The roof!"

The dosimetrist flicked the switch of the ranges back and forth, muttering: "Off the scale.... Off the scale...."

"You just take it and throw it you know where! Blockheads...." They went to take a tour around the turbine hall....

Around on the asphalt there was graphite and chunks of fuel. Not entirely distinguishable in the darkness, but you could figure it out if you wanted to. As a matter of fact, you would stumble against the graphite blocks and kick them away like in soccer. The actual radioactivity was about 15,000 roentgens per hour. Which is why it went off the scale of the dosimetrist's radiometer.

The mind did not take in what the eyes had seen. Their tour took in a cross section of the turbine hall. There were 19 fire engines lined up along the concrete wall of the intake pond. The din and the howl of the fire on the roof of the turbine hall were audible. The flame was high. Higher than the ventilation stack.

But it was a horrible affair! At this point, there were two images, two thoughts, as it were, occurring and living in the mind of the deputy chief engineer for operations of Unit 4. One: "The reactor is intact. Feedwater." The other: "Graphite on the ground, fuel on the ground. Where do you suppose it came from. Not clear from where. Raging radioactivity. I sense the radioactivity inside."

"That's enough!" Dyatlov ordered. "Let's go back!"

They returned to the unit control room. Gorbachenko went off to himself to the dosimetry panel. Krasnozhon, deputy chief of the radiation safety department, was supposed to arrive any time.

The total exposure they had received was 400 rads.

By 0500 hours, vomiting had begun. Fatal weakness. Headache. Reddish brown color of the face. Nuclear sunburn.

Gorbachenko and Dyatlov went off under their own power to the ABK-1 and beyond—to the "ambulance" at the medical unit.

4

Testimony of Alfa Fedorovna Martynova, wife of V.V. Maryin, head of the nuclear power industry sector of the CPSU Central Committee:

"On 26 April 1986 at 0300 hours, the intercity phone rang in our house. Bryukhanov was calling Maryin from Chernobyl. When he finished the conversation, Maryin told me: 'A horrible accident at Chernobyl; but the reactor is intact....' He quickly dressed and called for his car. Just before he left, he called the highest leadership of the party's Central Committee up through channels. First of all, Frolyshev. He in turn called Dolgikh. Dolgikh called Gorbachev and the members of the Politburo. After that, he left for the Central Committee. At 0800 hours, he called home and asked me to prepare his things for a trip: soap, tooth powder, toothbrush, towel, and so on."

At 0400 hours, Bryukhanov received an order from Moscow: Organize the continuous cooling of the nuclear reactor.

At the dosimetry control panel of the second stage, Nikolay Gorbachenko was replaced by Krasnozhon, deputy chief of the radiation safety department of the power plant. In answer to the questions of the operators as to how much to work, he always made the same answer: at a range of 1,000 microroentgens per second, it was off scale. Work 5 hours on the assumption of 25 rems.[6] (This indicates that the deputy chief of the radiation safety service of the nuclear plant could not himself determine the true intensity of the radiation.)

Akimov and Toptunov had already run up several times to the reactor to see the effect of the flow of water from the second emergency feedwater pump. But the fire continued to howl and to howl. Akimov and Toptunov were already reddish brown from the nuclear sunburn, already nausea had upset their insides, Dyatlov, Davletbayev, and people from the turbine hall were already at the medical unit, they had already sent unit shift chief Vladimir Alekseyevich Babichev to replace Akimov, but...Akimov and Toptunov were not leaving. One can only bow his head in the face of their bravery and fearlessness. After all, they condemned themselves to a certain death. Nevertheless, all of their actions followed from a false original premise: the reactor was intact!

They were utterly unable to believe that the reactor had been destroyed, that the

water was not going to it, but, taking the nuclear trash along with it, it was flowing to the minus levels, soaking the cableways and high-voltage distribution equipment and creating a threat of taking power from all three power-generating units that were operating.

Something was keeping the water from getting to the reactor, Akimov guessed. Somewhere along the pipeline, the valves were closed.... He and Toptunov went to the feedwater room at level 24 of the reactor department. The room was half-destroyed by the explosion. At the far end, a break through which the sky could be seen, the floor was covered with water and nuclear fuel with a radioactivity of about 5,000 roentgens per hour. How long could a man live and work in such radiation fields? Not long, that was for certain. Yet, there were the factors of the emotional high, extraordinary inner collectedness, mobilization of all energies from the delayed consciousness of guilt, responsibility, and duty to people. And strength from somewhere generated itself. They should already have been dying, but they were working...!

And the air here, just like everywhere around and within Unit 4, was heavy, pulsed with the radioactive ionized gas, saturated with the entire range of long-lived radionuclides which the destroyed reactor was disgorging.

By dint of great effort, they cracked open by hand the control valves on two feedwater lines, and then climbed over the debris to level 27, and in the small piping space in which a mixture of water and fuel was almost up to the knees, they blew (cracked open) two valves on the 300 line. There were still the single valves on the left and right lines, but neither Akimov nor Toptunov any longer had the strength to open them, nor did Nekhayev, Orlov, nor Uskov, who were helping them.

Making a preliminary assessment of the situation and the actions of the operating personnel after the explosion, we can say that the turbine operators in the turbine hall, the firemen on the roof, and the electricians headed by Aleksandr Grigoryevich Lelechenko, deputy chief of the electrical shop, displayed unconditional heroism and self-sacrifice. These people prevented development of the disaster both inside and outside the turbine hall and thus saved the entire plant.

Aleksandr Grigoryevich Lelechenko, protecting the young electricians from going unnecessarily into the zone of high radiation, himself went into the

electrolysis space three times in order to turn off the flow of hydrogen to the emergency generators. When we take into account that the electrolysis space was alongside the pile of debris, and fragments of fuel and reactor graphite were everywhere, and the radioactivity was between 5,000 and 15,000 roentgens per hour, one can get an idea of how highly moral and heroic this 50-year-old man was when he deliberately shielded young lives behind his own. And then in radioactive water up to his knees, he studied the condition of the switchboxes, trying to supply voltage to the feedwater pumps....

His total exposure dose was 2,500 rads, enough to kill him five times. But after he had received first aid (they injected physiological solution into his vein) at the medical station in Pripyat, Lelechenko rushed back to the unit and worked there several more hours.

He died a terrible painful death in Kiev.

The heroism of Valeriy Ivanovich Perevozchenko, chief of the reactor shop shift, Petr Palamarchuk, adjuster, and Nikolay Gorbachenko, dosimetrist, who rushed to rescue their comrades, is beyond dispute.

As for the actions of Akimov, Dyatlov, and Toptunov and those who helped them, their effort, full of selfsacrifice and fearlessness, was nevertheless directed toward making the emergency situation worse.

A false model and assessment of what had happened: the reactor was intact, it had to be cooled, the devastation had been caused by an explosion of the safety control system tank in the central hall—on the one hand, somewhat calmed Bryukhanov and Fomin, who reported that model of the situation to Moscow and immediately received an order in reply: continuously feed water into the reactor, cool it, while on the other hand.... Temporarily, this order seemed to relieve some of the worry and appeared to impart clarity to the situation: feed water, and everything will be fine. That in fact determined the entire character of the actions of Akimov, Toptunov, Dyatlov, Nekhayev, Orlov, Uskov, and others who did everything to get the emergency feedwater pump going and to supply water to the reactor which they imagined to be intact and undamaged. This thought kept Bryukhanov and Fomin from losing their senses; after all, it instilled hope....

But the store of water in the deaerator tanks was exhausted (only 480 m^3). To be sure, they did connect a feed there from the chemical water treatment unit, from

other reserve tanks, thereby eliminating the possibility of making up for leaks in the three other power-generating units that were operating. There, especially at the neighboring Unit 3, an extremely difficult situation had come about, one which threatened the loss of cooling to the core.

Yuriy Eduardovich Bagdasarov, Unit 3 shift chief, must be given his due; in the control room at the moment of the accident in the neighboring unit he had breathing masks and potassium iodide tablets. As soon as the radiation situation worsened, he ordered all his subordinates to put on the masks and take the tablets. When he realized that all the water from the pure condensate tanks and chemical treatment had been connected to the unit where the accident occurred, he immediately reported to Fomin in the shelter that the reactor should be shut down. Fomin forbade it. Toward morning, Bagdasarov himself shut down Unit 3 and put the reactor in the cooling-off state, circulating water through it from the bubbler pond. He acted courageously and displayed the highest degree of professionalism when he prevented meltdown of the core of the third reactor on his shift....

During that time, Bryukhanov and Fomin were constantly on the telephone in the shelter in ABK-1. Bryukhanov was talking to Moscow, Fomin to the control room of Unit 4.

One and the same model of the situation was repeated 1,000 times to Moscow, to Maryin in the Central Committee, to Mayorets, the minister, to Veretennikov, chief of Soyuzatomenergo, and in Kiev to Sklyarov, Ukrainian power minister, and Revenko, oblast committee secretary: "The reactor is intact, we are feeding water into the system. The emergency safety control system tank in the central hall exploded. The explosion carried away the roof. The radiation situation is within normal limits. One person died—Valeriy Khodemchuk, Vladimir Shashenok has suffered 100-percent burns. In grave condition."

"The radiation situation is within normal limits...." Just think of it! Of course, he had instruments whose measuring range went only to 1,000 microroentgens per second (which is 3.6 roentgens per hour), but who prevented Bryukhanov from having a sufficient number of instruments with a wide range of measurements? Why were the instruments shut up in the locker, and why were those which the dosimetrist had not in proper working condition? Why did Bryukhanov ignore the report of Solovyev, the plant's civil defense chief, and why did he not send on to Moscow and Kiev Solovyev's figures on the radiation situation?

The factors involved here included, of course, cowardice, a fear of responsibility, and—because of incompetence—disbelief in the possibility of such a terrible disaster. Indeed, for him what happened was inconceivable. But that only explains his actions, it does not justify them.

Bryukhanov received a message from Moscow that a government commission had been organized, that the first group of specialists from Moscow would be taking off at 0900 hours.

"Hold on! Cool the reactor!"

At times, ^omin lost his composure. He would fall into a stupor, then begin to wail and cry, to pound on the desks with his fists and his forehead, and then he would work up frantic and feverish activity. His sonorous baritone was filled with maximum tension. He brought pressure to bear on Akimov and Dyatlov, demanding that water be fed continuously to the reactor, he transferred to Unit 4 more and more people to replace those who were becoming disabled.

When they sent Dyatlov off to the medical unit, Fomin called in Anatoliy Andreyevich Sitnikov, deputy chief engineer for operation of the first stage, and said: "You are an experienced physicist. Determine what state the reactor is in. As a man coming from outside, you have no reason to lie. I beg of you. Best to climb up on the roof of Unit C and look from above. And...?"

Sitnikov went out to meet his death. He toured the entire reactor unit, he made a stop at the central hall. Even there, he realized that the reactor had been destroyed. But he did not feel this was sufficient. He climbed onto the roof of Unit C (specialized chemical unit) and from there he looked at the reactor as might a bird in flight. The scene of unimaginable devastation was open to his gaze. The explosion had torn away the cast-in-place roof of the central hall, and the pathetic remnants of the caved-in concrete walls with the shapeless tentacles of reinforcing steel protruding in every direction were reminiscent of a gigantic sea anemone waiting in concealment for the next living creature to come close to it, whereupon it would plunge into its hellish nuclear belly. Sitnikov drove away the obtrusive image, and feeling the hot radioactive tentacles licking at his face and hands, scorching and burning his brain and his very soul, his insides, he began to examine fixedly what remained of the central hall. The reactor had clearly exploded. The slab of the upper biological shield, with stumps of pipes and bundles of signal wires sticking out in every direction seemed to have been

hurled up by the explosion, and when it crashed down, it lodged in a slanting position on the shaft of the reactor. The fire was howling from the melted openings to the right and left, producing an intolerable heat and stink. Sitnikov's entire body, especially his head, was being directly irradiated by neutrons and gamma rays. He was breathing the thick radionuclide gas, more and more he was feeling an intolerable burning in his chest, as though someone was tearing apart his skeleton from within. The fire continued to burn and to burn....

He received at least some 1,500 roentgens to the head. The central nervous system was affected by the irradiation. In the Moscow clinic, they did not inject bone marrow into him, and he died in spite of all the steps that were taken.

At 1000 hours, Sitnikov reported to Fomin and Bryukhanov that the reactor was in his opinion destroyed. But the report by Anatoliy Andreyevich Sitnikov caused irritation and was not honored. The feeding of the water into the reactor continued.

As we have already said, the first people to receive the blow of the nuclear disaster within the power-generating unit were Kurguz and Genrikh, central hall operators, Valeriy Khodemchuk, main circulating pump operator, the adjuster Vladimir Shashenok, Razim Davletbayev, deputy chief of the turbine shop, and the turbine machine operators Brazhnik, Tormozin, Perchuk, Novik, Vershinin....

And outside the unit the first to become fearlessly involved in fighting the fire were the firemen of Major Telyatnikov. Leonid Petrovich Telyatnikov, commander of the fire company, had an off-day and was supposed to return to work a day later. He was just celebrating his birthday with his brother when they called from the station. When he reached the scene of the fire, Telyatnikov immediately realized that there were not enough men and he had to call help from somewhere. He ordered Lieutenant Pravik to sound the alarm in the oblast. Pravik issued call No 3 over the walkie-talkie, which meant that all fire trucks in Kiev Oblast were to come to the nuclear power plant, wherever they might be.

Firemen Shavrey and Petrovskiy climbed up to the roof of the turbine hall from the hook-and-ladder truck. A storm of fire and smoke was raging there. The boys from the sixth unit, who were feeling bad, came to meet them. They helped them down the truck ladder, and they rushed to the fire....

Prishchepa connected to the hydrant, and his team climbed up the fire ladder to

the roof of the turbine hall. When they reached the top, they saw that the roof had been destroyed in several places, some of the panels had fallen down in, while others were very unstable. Prishchepa went down to alert his comrades to this. He spotted Major Telyatnikov. He reported to him. "Set up a permanent battle station and do not leave it until victory," Telyatnikov said.

That is what they did. With Shavrey and Petrovskiy, Prishchepa stayed on the roof of the turbine hall until 0500 hours. Then they were bad off. More accurately, they had felt bad almost immediately, but they had tolerated it, they had thought that it came from the smoke and fumes. But at 0500 hours it had become really bad, fatally bad. Then they went down. But by then the fire had been put out....

Within 5 minutes after the explosion, Andrey Polkovnikov's team was also at the scene of the accident. He turned his truck around and prepared to put water on the fire. He climbed to the roof twice to carry orders from Telyatnikov as to how to proceed.

Pravik was the first to arrive at the disaster scene, which is why his entire watch was sent to extinguish the roofing of the turbine hall. Kibenok's watch, which arrived a bit later, rushed to the reactor department. There the flame was raging at various levels. It was burning at five points in the central hall. Kibenok, Vashchuk, Ignatenko, Titenok, and Tishchura also rushed to fight that fire. This was combat against fire in the nuclear hell. When they extinguished the sources of fire in the separator rooms and in the reactor hall, there remained only the last and most important source—the reactor. At first, they did not get their bearings, they began to spray the core, which was howling with fire, from high-pressure fire hoses. But the water was powerless against the uncontrolled nuclear force. You cannot extinguish neutrons and gamma rays with water....

Until Telyatnikov arrived, Lieutenant Pravik took upon himself general supervision of the effort to put out the fire. He himself went and scouted everything in detail.

He repeatedly went to the reactor, he climbed onto the roof of Unit C (level 71) to see the entire scene from there and to determine the tactics for fighting the fire. When Telyatnikov turned up, Pravik became his right hand, his first assistant.

The fire had to be stopped along the decisive directions. Telyatnikov sent one squad to protect the turbine hall, two others halted the advance of the seething fire to neighboring Unit 3, and they also put out the fire in the central hall.

Having heard Pravik's report, Telyatnikov himself climbed several times to level 71 in order to get a better look at the direction of the fire's movement. The situation was after all changing from minute to minute. The lava of hot asphalt, the heavy poisonous smoke, diminished visibility and made it difficult to breathe. They worked under the threat of unexpected eruptions of flame and sudden structural collapses. In all, they extinguished 37 sources of fire in the reactor department and on the roof of the turbine hall.

The smoke burned the eyes, the melted asphalt stuck to their boots, and their helmets were showered with the hot radioactive ash of burning graphite and keramzit. Leonid Shavrey, who was in Pravik's squad, stayed at the post on the roof of Unit C, seeing that the fire did not jump anywhere else. It was horribly hot. Both outside and inside. No one at that point suspected radiation. Fire is fire, they did not notice anything supernatural. Shavrey even took off his helmet. It was suffocating, there was pressure on his chest, he choked with a cough. But then the men became disabled one after the other. Nausea, vomiting, mental confusion. At 0330 hours, Telyatnikov went down to Akimov in the unit control room. He reported the situation on the roof. He said that something bad was happening to the boys. Was it radiation? They called for the dosimetrist. Gorbachenko came. He said that the radiation situation was problematical. He sent his assistant Pshenichnikov to Telyatnikov.

They started by way of the stairway-elevator well, which ended at the top with a door to the roof. But the door turned out to be locked. They were unable to break it down. They went back down to level 0 and went along the street. They walked over graphite and fuel. Telyatnikov was already sick: his face was reddish brown, vomiting and headache. But he thought he had been poisoned by the smoke and had gotten overheated in the fire. And still.... They wanted to get a more accurate idea. Pshenichnikov had a radiometer that went to 1,000 microroentgens per second. Everywhere, below and on the roof, the indicator went off scale, but the dosimetrist was unable to determine the true radiation situation. His radiometer showed only 4 roentgens per hour. As a matter of fact, from place to place on the roof it ranged from 2,000 to 15,000 roentgens per hour. The roof after all had caught fire from the glowing graphite and fuel that fell on it. Once it mixed with the melted asphalt, all of this turned into a highly

radioactive nuclear mash which the firemen were walking over.

Down below, on the ground, as I have already said, it was no better. Not only graphite and fragments of fuel, but also nuclear dust which had fallen from the explosion cloud and covered everything with a thin poisonous coating.

The driver V.V. Bulava relates: "I received an order to put myself under the disposition of Lieutenant Khmel. I went there. I set up the truck where the water was and turned on the water supply. My truck had just been repaired, it was just like new, it smelled of fresh paint. The wheels also had new tires and tubes. Just as I was approaching the unit, I heard something strike the right front fender. I jumped out to see what it was. There it was—a piece of reinforcement steel had pierced the tire, it was sticking out of the wheel and catching the fender. Well, mother fucker, such a shame, enough to make you cry. It had just been repaired, such a pity. But for the present I hooked the machine up to the water, there was no time. And then I turned on the pumps, sat in the cab, but that piece of iron kept pestering me. I got out and saw that it had punctured the tube and was celebrating. No, I thought, I will not put up with anything like that. I climbed down from the truck and pulled at the damned thing. It did not give. It gave me plenty of trouble.... And ultimately I ended up in the Moscow clinic with deep radiation burns on my hands. Had I known, I would have put on gloves. That's life...."

Kibenok's firemen along with their commander were the first to be disabled. Lieutenant Pravik was also in the first group of those affected. By 0500 hours, they had put out the fire. But a high price had been paid for the victory. Seventeen firemen, among them Kibenok, Pravik, Telyatnikov, were sent off to the medical unit and on the evening of that same day to Moscow. In all, 50 fire trucks came to help at the scene of the accident from Chernobyl and other rayons in Kiev Oblast. But the main job had already been done.

Valentin Belokon, pediatrician, was on duty in the "emergency room" of the Pripyat medical unit on that fatal and heroic night. He and physician's assistant Aleksandr Skachok worked with two teams. Belokon was on a call to a patient when they called from the nuclear power plant. Skachok, the physician's assistant, went to the power plant.

At 0142 hours, Skachok called and said that there was a fire at the plant, people had been burned, a physician was needed. Belokon went with his driver

Gumarov. They took another two spare vehicles. Along the road, they met Skachok's ambulance coming with its blinking light. As it later turned out, he was transporting Volodya Shashenok.

They broke down the boarded-up door of the medical station. Belokon went to Units 3 and 4 several times. He walked over the graphite and fuel. Titenok, Ignatenko, Tishchura, and Vashchuk were already in a very bad state when they climbed down from the roof. By 0600 hours, Belokon was also feeling bad and was sent off to the medical unit.

The first thing that struck him when he saw the firemen was their terrible excitement, at the limit of their nerves. He had not observed that previously. That is why he injected them with a tranquilizer. But, as it turned out later, this was the nuclear fury of the nervous system, the false supertonus, which was then displaced by profound depression....

Testimony of Gennadiy Aleksandrovich Shasharin, former USSR deputy minister for power and electrification:

"At the moment of the explosion, I was in a sanatorium in Yalta. My wife and I were on vacation. At 0300 hours on 26 April 1986, the telephone rang. They were calling from the Yalta department to say that there had been a serious accident at the Chernobyl Nuclear Power Plant, that I was appointed chairman of the government commission and that I was to fly immediately to the scene of the accident in Pripyat. I quickly dressed, went to the administrator on duty and asked him to connect me to the VPO Soyuzatomenergo in Moscow. G.A. Veretennikov was already there (about 0400 hours). I asked him: 'Did they use the emergency safety system? Are they feeding water?' 'Yes,' Veretennikov replied.

"Then, the sanatorium administrator brought me a telex signed by Mayorets, the minister. The telex mentioned already that Boris Yevdokimovich Shcherbina, deputy chairman of the USSR Council of Ministers, had been appointed chairman of the government commission and that I also had to be in Pripyat on 26 April. I was to take off immediately.

"It was just after 1000 hours when I arrived at Simferopol. The flight to Kiev was expected at 1100 hours, and I stopped by the oblast party committee. The people there plainly knew nothing. They expressed uneasiness about

construction of the nuclear power plant in the Crimea. I arrived in Kiev about 1300 hours. Sklyarov, the Ukrainian power minister, told me that Mayorets was to fly in at any moment with his team, that we should wait...."

The story is taken up by Viktor Grigoryevich Smagin, Unit 4 shift chief:

"I was supposed to replace Aleksandr Akimov at 0800 hours on the morning of 26 April 1986. I had a good sleep that night. I heard no explosions. I woke at 0700 hours and went out on the balcony to have a smoke. From my apartment on the 14th floor I have a good view of the nuclear power plant. I looked in that direction and immediately realized that the central hall of my own Unit 4 had been destroyed. There was fire and smoke over the unit. I realized that things were rotten. I rushed to the telephone to call the unit control room, but the phones had already been cut off. To keep the information from leaking. I got ready to leave. I told my wife to close the doors and windows tightly. Not to let the children out of the house. Not to go out herself either. To sit at home until 1 came back....

"I ran out into the street to the bus stop. But the bus did not go up to the plant. Soon, they sent a radio message saying that they would not go to the second passageway as usual, but to Unit 1. Everything there had already been cut off by the police. The officers were not letting anyone through. Then, I showed my 24-hour pass for supervisory operating personnel, and they let me through, but reluctantly. Near ABK-1,1 met Gundar and Tsarenko, Bryukhanov's deputies, who were headed for the shelter. They told me: 'Go to Unit 4, Vitya, to take Babichev's place. He replaced Akimov at 0600 hours, it probably has already got him.... Don't forget to change clothes in the "greenhouse."

"If I was changing clothes here, I reasoned, in ABK-2, then there was radiation. I went up to the 'greenhouse' (conference room). There was a pile of clothing there: coveralls, high boots, breathing masks. While I was changing clothes, I saw an MVD general (this was Bedrov, who was Ukrainian deputy minister of internal affairs), who was on his way to Bryukhanov's office.

"I changed clothes quickly, not knowing at that point that I would be coming back from the unit to the medical station with severe nuclear sunburn and a dose of 280 rads. But now I was in a hurry, I put on the cotton coveralls, the high boots, the cap, the 'respirator-200' and ran along the long corridor of the deaerator galleries (which connected all four units) toward Unit 4. In the room

that housed the 'Skala' computer, there had been a break, water was flowing from the ceiling onto the cabinets containing the equipment. At that point, I still did not know that the water was highly radioactive. There was no one in the room. Yura Badayev was nowhere to be found, they had already taken him away. I went on further. Krasnozhon, deputy chief of the radiation safety department, was already at work in the room containing the dosimetry panel. Gorbachenko was not there. They had probably already taken him away, or he was somewhere else in the unit. Samoylenko, chief of the night shift of dosimetrists, was also in the room. Krasnozhon and Samoylenko were abusing one another with bad language. I listened in and understood that the cursing was because they could not determine the radiation situation. Samoylenko was pressing the point that the radiation was immense, while Krasnozhon was saying that it was possible to work 5 hours on the assumption of 25 rems.

"'How long to work, guys?' I asked, interrupting their squabble. 'The background is 1,000 microroentgens per second, that is, 3.6 roentgens per hour. You can work 5 hours on the assumption of accumulating 25 rems!' 'It's all lies,' Samoylenko summed up. Krasnozhon became enraged all over again. 'What, you have no other radiometers?' I asked. 'In the locker, yes, but it is obstructed by the explosion,' Krasnozhon said. 'The chiefs did not foresee such an accident....' 'And what are you, if not chiefs?' I thought and went on my way.

"All the windows in the corridor of the deaerator galleries had been broken by the explosion. There was a very acrid smell of ozone. My organism felt the strong radiation. But they say that there are no such sense organs. Evidently, still there is something. There was an unpleasant feeling in the chest—an arbitrary sense of panic, but I controlled myself and kept my grip. It was already light, and the pile of debris was already quite visible through the window. Something black was strewn everywhere on the asphalt. I took a look—so it was reactor graphite! Not bad! I understood that the reactor was in a bad way. But the full reality of what had happened still did not get through to me.

"I entered the unit control room. Vladimir Nikolayevich Babichev and Mikhail Alekseyevich Lyutov, deputy chief engineer for science, were there. He was sitting at the desk of the unit shift chief. I told Babichev that I had come to replace him. It was 0740 hours. Babichev said that he had come on duty 1.5 hours before and felt normal. In such cases, the arriving shift falls under the command of the shift that is working. 'Akimov and Toptunov are still in the unit,' Babichev said, 'they're opening valves. Go, Viktor, replace them. They are

bad off....'

"Lyutov, the deputy chief engineer for science, was sitting there holding his head in his hands, dully repeating: 'Tell me, lads, the temperature of the graphite in the reactor.... Tell me, and I will explain everything to you....' 'What graphite are you asking about, Mikhail Alekseyevich?' I said in amazement. 'Almost all the graphite is on the ground. Go look.... It is already light in the yard. I just saw it....' 'You what?!' Lyutov asked in a frightened and distrustful tone. 'It doesn't make sense....' 'Let us go see.'

"He and I went to the corridor of the deaerator galleries and entered the backup control room, which was closer to the pile of debris. The explosion had also broken the windows there. The glass cracked and screeched under our feet. The air, saturated with long-lived radionuclides, was dense and stinging. Gamma rays were streaming directly from the pile of debris with an intensity of about 15,000 roentgens per hour. But I did not know about that at the time. My eyelids burned, my throat, it checked my breathing. The heat inside came to the face, it dried the skin and stretched it.

'"There, you see: that black all around from the graphite....' 'Can that be graphite?' Lyutov did not believe his eyes. 'Then what is it?' I exclaimed in confusion, and in the depth of my soul I myself also did not want to believe what I saw. But I already understood that people would die in vain because of the lie, it was time to face up to everything. With vicious obstinacy, kindled by the radiation, I continued to argue with Lyutov: 'You see! Graphite blocks. That after all is clearly distinguishable. There is a block with the ear (protrusion), and there is another one with the recess. And the holes in the middle for the production channel. Surely you see?' 'Yes, I see.... But is it graphite...?' Lyutov continued to doubt. This blindness in people had always driven me to distraction. To see only what you wanted to see. But it meant death! 'But what else could it be?!' I began once again to shout at the chief. 'How much of it is there here?' Lyutov finally came to himself. 'It is not all here.... If it ejected it, then it did so in every direction. But obviously not all.... From my balcony at home, at 0700 hours I saw the fire and smoke coming from the floor of the central hall.'"

They went back to the unit control room. There was also a strong smell of radioactivity there, and Smagin caught himself literally for the first time seeing his own Unit 4 control room, its panels, its instruments, its boards and displays. It was all dead. The pointers of the indicating instruments had gone dead either

off scale or at zero. The DREG computer of the "Skala" system, which during the unit's operation continuously printed out parameters, was silent. All of these diagrams and printouts would now be waiting for their moment. The curves of the production process had been frozen in them, the figures were mute witnesses of the atomic tragedy. Soon, they would cut them out and take them off to Moscow as the greatest treasure for gaining an idea of what happened. The logs from the unit control room and all the work stations would also go off there. Later, all that would be called the "bag of papers," but for the moment.... Only 211 round synchroindicators of the position of the control rods stood out distinctly against the general dead background of panels lighted from within by the emergency lamps for lighting up the dials. The pointers of the synchros were frozen in the position of 2.5 meters, 4.5 meters short of the bottom....

Smagin ran up the stairway-elevator well to replace Toptunov and Akimov. Along the way, he met Tolya Sitnikov. He was in a bad way, fighting weakness, and he said: "I have seen everything.... On assignment from Fomin and Bryukhanov, I have been in the central hall, on the roof of Unit C. There is a great deal of graphite and fuel there. I looked into the reactor from above.... In my opinion, it is destroyed. There is a howling fire...." Swaying, he started down, and Smagin ran up.

Akimov and Toptunov, who had become puffy and had turned a deep reddish brown, spoke with difficulty. They were experiencing terrible sufferings and at the same time a feeling of bewilderment and guilt. "I don't understand anything," Akimov was hardly able to move his swollen tongue, "we did everything correctly.... Why?... Oh, I feel bad, Vitya, we are done. We think we have opened all the valves along the way. Check the third one on each line...."

It is strange, but an absolute majority of the operators, Smagin included, had taken what they wanted to see for reality in those incredible hours. "The reactor is intact!"—that saving thought that eased the soul cast a spell on many here, in Pripyat, in Kiev, and indeed even in Moscow, whence ever fiercer and more persistent orders came: supply water to the reactor! The orders instilled confidence and imparted strength when by all the biological laws they should not have had any....

The pipeline in Room 712 was half-submerged. That water was emitting about 1,000 roentgens per hour. All the valves were without power. They had to be turned by hand. Akimov and Toptunov turned for several hours, they took in

lethal doses. The water, which was not going to the reactor, was drenching the cableways, compounding the accident.... Smagin set to work on the third valves along the way, but it turned out that they had been opened. He began to open them further. He was in the room about 20 minutes and took a dose of 280 rads.

Descending to the unit control room, he replaced Babichev. With Smagin in the unit control room were the senior engineers of the unit management Gashimov and Breus, the SIUR Sasha Cheranev, his backup man Bakayev, and Kamyshnyy, chief of the reactor shop shift. He ran around the unit, mainly using the deaerator galleries, to cut off the two left deaerator tanks, from which water had reached the damaged emergency feedwater pump. But he was unable to cut them off. After the explosion, the deaerator galleries ended up approximately .5 meter away from the cast-in-place concrete, the rods having pulled out. It had become impossible to manipulate the valves even by hand. They tried to put it back in service, to insert pieces, but the high intensity of the gamma fields did not allow them to do this. People were disabled. Kamyshnyy was helped by Kovalev, a senior turbine machine operator, and Kozlenko, a lathe operator.

At 0900 hours, the emergency feedwater pump that was operating shut down, which was a blessing. They stopped pouring water into the lower areas. The water ended up in the deaerators. Smagin was in communication with Fomin and Bryukhanov, and the latter were in contact with Moscow. The report went off to Moscow: "We are supplying water!" An order came back in the other direction: "Do not stop feeding water!" But that water did stop. Fomin searched feverishly for a way out. Finally, he thought of something. He sent Leonid Konstantinovich Vodolazhko, deputy chief engineer for new units, and Babichev, unit shift chief, to organize the flow of water into the clean condensate tanks, and then in turn to the reactor by means of the emergency pumps. Fortunately, this escapade of Fomin's was not successful.

During the day of 26 April, new fire-fighting teams arriving at Pripyat would pump the water and fuel from the interstory cableways of the nuclear power plant and dump it into the cooling pond, where the radioactivity of the water over the entire area would reach the sixth power of curies per liter, that is, it would be equal to the radioactivity of the water in the main loop while the nuclear reactor was operating.

More than 100 people had already been sent to the medical unit. It was time to be reasonable. But no—the folly of Bryukhanov and Fomin continued: "The

reactor is intact! Pour water into the reactor!"

But in the depths of his soul Bryukhanov apparently had still taken note of the information from Sitnikov and Solovyev and he requested Moscow's "go-ahead" to evacuate Pripyat. But a clear order came from Shcherbina, with whom his consultant L.P. Drach was in telephone contact (Shcherbina was at that time in Barnaul): Do not cause a panic.

And at that time Pripyat, a city of nuclear power plant workers, was waking up. Almost all the children had set off for school....

Testimony of Lyudmila Aleksandrovna Kharitonova, senior engineer of the production and distribution division of the construction administration of the Chernobyl Nuclear Power Plant:

"On Saturday, 26 April 1986, all preparations had been made for the May Day holiday. The weather was warm that day. It was springtime. The gardens were in flower. My husband, chief of the section for adjustment of the ventilation, intended to go off with the children to the dacha after work. I had been washing since morning and hanging out bed linen on the balcony. Even by evening, millions of particles had accumulated on it. Among most of the construction and installation workers, no one knew anything as yet. Then, something leaked out about the accident and the fire at Unit 4. But what had actually happened no one really knew.

"The children went to school, small children played in the street in sandboxes, they rode their bicycles. By the evening of 26 April, the radioactivity in the hair and clothing of all of them was already high, but we did not know that at the time. In our street, not far away they were selling tasty doughnuts. It was an ordinary day off.

"The construction workers went off to work, but they soon came back somewhere around noontime. My husband also drove to work, and he said when he came back: 'There's been an accident, they're not letting people in. The police have blocked off the plant....'

"We decided to go to the dacha, but the police were stationed on the road and would not let us out of town. We went back home. Strange, but we still perceived the accident as something separate from our private life. After all, there had been accidents before, but they concerned only the plant itself....

"After lunch, they began to wash the streets of the city. But this did not attract attention. It was something ordinary on a hot summer day. The sprinkler trucks were nothing unusual in the summer. An ordinary peaceful situation. Though I did somehow pay passing attention to the white foam in the gutters, but I paid it no importance. I thought that the water pressure was high.

"A group of neighborhood children were riding their bikes on the overpass; from there, you had a good view of the unit where the accident had occurred from the direction of Yanov Station. We were to learn later that this was the most radioactive place in the city, because the cloud of radioactive discharge had passed there. But that became clear later, while at the time, the morning of 26 April, the children were simply interested in looking at the reactor burning. Those children later developed serious radiation disease.

"After lunch, our children came back from school. They had been warned there not to go out in the street, to do a housecleaning with water, that was when people first realized that it was serious.

"Different people learned about the accident at different times, but by the evening of 26 April almost everyone knew, but still the reaction was calm, since all the stores, schools, and institutions were open. We thought that that meant that it was not so dangerous.

"It became more disturbing as evening approached. This uneasiness spread from who knows where, perhaps from the soul within, perhaps from the air in which the metallic odor had become strong. What it was, I cannot even say precisely. But metallic....

"In the evening, the fire was more intense. They said the graphite was burning. People saw the fire from far away, but they paid no particular attention. 'Something is burning....' 'The firemen have put it out....' 'It is still burning.'..."

At the industrial plant site, which is 300 meters from the destroyed power-generating unit, the guard Dan i la Terentyevich Miruzhenko was waiting for 0800 hours in the office of Gidroelektromontazh, and since the chief of the administration had not been answering his calls, he decided to set out 1.5 km to the construction administration and report there to V.T. Kizima, chief of the construction project, or to the dispatcher about what he had seen at night. No one had come to replace him in the morning. Nor had anyone called him on the

telephone about what he was to do. Then, he locked up the office and set off on foot to the construction administration. He was already feeling very bad. Vomiting had begun. He saw in the mirror that he had become badly sunburned during the night. What is more, in setting out for the construction administration, for a time he was walking along the trail of the nuclear discharge.

He arrived at the administration, but it was locked up. There was no one. But it was Saturday. Some peasant he did not know was standing near the porch. He saw Miruzhenko and said: "Get yourself to the medical unit quickly, granddad. You are in a very bad way." Miruzhenko somehow limped to the medical unit....

A crew of construction workers rode to Unit 5 on the morning of 26 April. Vasiliy Trofimovich Kizima, a fearless and courageous man who was chief of the construction project, arrived at the same place. Before that, he had gone by car to look at the pile of debris around Unit 4. He had no dosimeters, and he did not know how much he had taken. He later told me: "I guessed, of course, my chest was already very dry, my eyes burned. I thought that the burning was not just incidental. Bryukhanov was surely spitting out radiation.... I looked at the pile of debris, I went off to Unit 5. The workers came to me with questions: How much to work? What was the radioactivity? They were demanding benefits for harmful working conditions. The coughing was choking them all, myself as well. The organism was rebelling against the plutonium, cesium, and strontium. Not to mention the iodine-131 that built up in the thyroid. It was hard to breathe. After all, no one had masks. Nor did they have tablets of potassium iodide. I called Bryukhanov. I asked for information about the situation. Bryukhanov replied: 'We are studying the situation.' I called him again closer to lunchtime. He was again studying the situation. I am a builder, not a nuclear expert, but I understood that Comrade Bryukhanov was not master of the situation. At 1200 hours, I discharged the workers to go home. To wait for further instructions from the management...."

Testimony of Vladimir Pavlovich Voloshko, chairman of the Pripyat Gorispolkom:

"...The entire day of 26 April Bryukhanov was beside himself, like a man who was lost. Fomin, he would cry in the pauses between issuing orders, he had lost his selfconfidence. Both of them more or less came to themselves by evening, by the time Shcherbina arrived. As though he could have brought salvation with him.... They sent Sitnikov, an excellent physicist, to take 1,500 roentgens! And

then they didn't listen to him when he reported that the reactor had been destroyed. Out of the 5,500 people on the plant labor force, 4,000 vanished to parts unknown on the very first day...."

At 0900 hours on 26 April, L.V. Yeremeyeva, who was on duty at Soyuzatomenergostroy in Moscow, telephoned the administration for construction of the Chernobyl Nuclear Power Plant. In Pripyat, it was the construction project's chief engineer Zemskov who picked up the receiver. Yeremeyeva asked him for the day's figures. "Don't bother us today. We have had a little accident here," Zemskov replied, having just made a conscientious tour of the damaged unit and having received a severe dose of radiation.

At 0900 hours on 26 April, a YaK-40 airplane took off from Bykovo Airport in Moscow on a special trip.

The airplane's passengers included the first interdepartmental operational team of specialists consisting of B.Ya. Prushinskiy, chief engineer of the VPO Soyuzatomenergo, Ye.I. Ignatenko, deputy chief of the same association, V.S. Konviz, deputy chief of the institute Gidroproyekt (the station's general designer), K.K. Polushkin and Yu.N. Cherkashov, representatives of NIKIET (the chief designer of the RBMK reactor), Ye.P. Ryazantsev, representative of the Atomic Energy Institute imeni I.V. Kurchatov, and others.

At 1045 hours, the emergency operational team was already in Kiev. Two hours later, the cars drew up to the headquarters of the Pripyat City Party Committee. They needed to familiarize themselves as rapidly as possible with the true state of affairs in order to have reliable information for a report when the members of the government commission arrived by plane.

The first thing would be to drive out to the damaged unit and examine everything with their own eyes. Still better to examine the unit from the air. It turned out that there was a civil defense helicopter in the vicinity that had landed not far from the overpass, which is near the Yanov Station. It took awhile to find binoculars and a photographer with a camera. They actually never found the binoculars, but they did find a photographer. The MI-6 helicopter rose into the air an hour or 1.5 hours after their arrival. On board were the photographer, B.Ya. Prushinskiy, chief engineer of the VPO Soyuzatomenergo, and K.K. Polushkin, representative of the reactor's chief designer. The pilot also had a dosimeter, which afterward made it possible to learn the radiation dose absorbed.

They approached from the direction of the concretemixing facility and the city of Pripyat. At an altitude of 400 meters. They dropped down to 250 to get a better look. It was a depressing scene. Utter disintegration, there was no central hall. The unit was unrecognizable. "Hover here," Prushinskiy requested.

Heaps of twisted beams, light-colored fragments of wall and roof panels, stainless steel pipe glittering in the sunshine, black pieces of graphite, and warped fuel assemblies rusty with corrosion were visible on the roof of the VSRO (auxiliary reactor department systems) unit, which was right next to the wall of Unit C (special chemical facility). The pile of fuel and graphite was particularly dense around the square ventilation stack, which protruded from the roof of the VSRO and was right next to the wall of Unit C. Beyond the pile of twisted pipelines, broken reinforced-concrete structures, equipment, fuel, and graphite sloped upward right from the ground (occupying an area on the ground with a radius of about 100 meters) from the former wall of the main circulating pump room at Row T, inside the demolished main circulating pump room, whose back wall on the side of the KhZhTO building (liquid and solid waste storage), which could be seen on the right, had miraculously remained intact.

It was exactly here, under this pile, that Valeriy Khodemchuk was buried, exactly here where Perevozchenko, reactor shop shift chief, absorbing a fatal dose of radiation, had searched for his subordinate, clambering over the heaps of structural fragments and equipment in the darkness and shouting shrilly in a throat that was parched and tightened by the radiation: "Valera! Reply! I am here! Respond!"

Prushinskiy and Polushkin did not know about all that, nor could they have known. But, shaken, understanding that what had happened was not simply destruction, but something far greater and terrible, absorbed to the smallest detail the disaster scene spread before them.

The dark black pieces of graphite and even entire bundles of graphite blocks were visible all over the asphalt, which was blue in the sunlight, and on the roof of the KhZhTO. A great deal of graphite, it was black with graphite....

Prushinskiy and Polushkin were struck dumb looking at all that incredible devastation. What they were now looking at in reality had previously been portrayed and simulated only in their imagination. But that, of course, was much paler and simpler and in large part purely theoretical. They both caught

themselves not wanting to look at all of this, as if it did not concern them at all, but was of concern to other people they were not connected with. But it did concern them, them in particular! And they burned with shame to have to look at such a thing. They were, as it were, repelled by the stinking scene of destruction. Oh, not to have to look at all that! But they had to! They had to...!

The impression was that the main circulating pump room had been demolished by an explosion from within. But how many explosions had there been?! Long large pipes, like headers, were visible in the pile that sloped upward from the ground all the way to the floor of the former separator room. One almost on the ground, another considerably higher, its upper end leaning on a long pipe of the downcoming pipeline, the explosion had probably thrown the pipeline up out of the shaft of the leaktight box. Beyond, on the floor, if the formless heap could be called the floor, at the +32 level, were the 130-ton drum separators displaced from their footings, eight pieces of attached pipes, glittering gaily in the sunshine, a pile of all kinds of rubbish, pieces of concrete floor and wall panels with girders dangling down. The walls of the separator room had been swept away except for an intact stump on the side of the central hall. Between the stump of the wall and the pile of debris was a rectangular gaping hole that opened into the blackness of the shaft of the leaktight box or the space of the reactor's upper piping. It seemed that some of the equipment and piping had been blown out of there by the explosion. That is, there had also been an explosion from there, which is why it was clear there, nothing was protruding....

Prushinskiy involuntarily recalled the main loop when it was brand new, after installation—a holy of holies for technology. And now.... Where the central hall adjoined the deaerator galleries, there was something left of the back wall down below. The back wall of the reactor hall at Row T was intact approximately to the +51 level (to the footing of the emergency tank of the safety control system). It was in that tank, according to Bryukhanov's report, that the hydrogen-oxygen mixture had exploded, destroying the central hall. Fine, but then what about the main circulating pump room, the drum separator compartments, the leaktight box? What had demolished them? No! Bryukhanov's report was mistaken, if not deceitful.

And on the ground around the pile the black debris of the reactor's graphite "brickwork." The eyes involuntarily kept going back there to look. After all, if there was graphite on the ground, that meant....

They did not want to become conscious of the thought that now was simple and obvious: the reactor had been destroyed.

After all, that admission would immediately raise immense responsibility to people. No.... To millions of people. To the entire planet Earth. And an unimaginable human tragedy.

Better simply to look. Without thinking, to absorb this nightmare of the agonizing nuclear unit stinking with radiation.

The uneven broken edges of the wall of Unit C protruded on the VSRO side. Pieces of the graphite "brickwork" of the reactor, square blocks with holes in the middle, could be clearly seen on the roof of Unit C. It was not possible that that could be a mistake. The helicopter hovered quite close to the roof of Unit C, at perhaps 150 meters. The sun was high in the sky. The lighting was clear, with good contrast. Not a cloud in the sky. Close to the back wall of Unit C, the graphite was piled in a heap. Pieces of graphite were uniformly scattered both on the roof of the central hall of Unit 3 and on the roof of Unit C, from which the ventilation stack protruded, white with red stripes. Graphite and fuel were also visible on the observation platforms of the ventilation stack. These radioactive "lanterns" were obviously "shining" in all directions. And there was the roof of the deaerator galleries, where 7 hours before the firemen of Major Telyatnikov had fought the fire to a finish....

The flat roof of the turbine hall seemed to have been pushed in, twisted reinforcing steel was protruding, wrenched metal grids, black incinerations. The hardened rivulets of asphalt, in which the firefighters had been stuck up to the knee in the night, glistened in the sun. On the sections of roof that had remained intact, there were long and crazily interwoven lengths and coils of fire hose.

At the back wall of the turbine hall, in the corners along Rows A and B and along the pressure basin were the red boxes of the fire trucks which the men had abandoned and were now highly radioactive, dumb witnesses of the tragic struggle of fragile people against the visible and invisible elements.

Further to the right was the far-stretching reservoir of the cooling pond, rowboats and motorboats lay on the golden sandy banks like children's toys, and ahead the deserted surface of the water which at that point was still clean....

People who had not managed to get away were leaving Unit 5, which was under

construction, in groups and individually. These were the workers whom Kizima, chief of the construction project, had sent home long ago, having not managed to get the truth from Bryukhanov. They would all follow the route of the radioactive cloud, they would all receive their dose and carry the terrible contamination home to their children on the soles of their shoes.

"Hover directly over the reactor," Prushinskiy asked the pilot. "That's it! Right there! Shoot that!"

The photographer took several pictures.

They opened the door and looked down. The helicopter was in the ascending flow of the radioactive discharge. None of them in the helicopter had masks. There was no radiometer.

Below, the black rectangle of the tank for holding spent fuel. No water could be seen in it.

"The fuel in the tank will melt," Prushinskiy thought. The reactor.... There it is—the round opening of the reactor shaft. Like a squinting eye. The immense eyelid of the reactor's upper biological shield was slewed around and heated to a bright cherry color. Flame and smoke were belching from the squinting eye. It was like a gigantic sty that was coming to a head and was about to burst....

"Ten rems," the pilot said, looking through the eyepiece of the optical dosimeter. "Several times today I will have to...." "Out of here!" Prushinskiy ordered. The helicopter slid off the central hall and set course for Pripyat. "Yes, lads, this is the end," Konstantin Polushkin, representative of the main designer, said thoughtfully.

Testimony of Lyubov Nikolayevna Akimova, Aleksandr Akimov's wife:

"My husband was a very amiable and sociable person. He had an easy way with people, but without familiarity. An obliging man who found a joy in life. Active in civic work. He was a member of the Pripyat Gorkom. He loved his sons very much. He was thoughtful. He loved to hunt, especially after he went to work in the unit and we bought a car.

"We came to Pripyat in 1976, after graduation from the Moscow Power Engineering Institute. We first worked in the Gidroproyekt group doing

blueprints. In 1979, my husband took a job in operating the plant. He worked as senior turbine management engineer, senior engineer of the unit management, shift chief of the turbine shop, and deputy chief of the unit shift. In January 1986, he became unit shift chief. That is the job he held at the time of the accident.

"On the morning of 26 April, he did not come home from work. I tried to call him in the Unit 4 control room, but the telephone did not answer. I also called Bryukhanov, Fomin, and Dyatlov. But the telephones did not answer. It was quite a bit later that I learned that the telephones had been disconnected. I was quite disturbed. The entire 1st half of the day I ran around, asked everyone, looked for my husband. Everyone already knew that there had been an accident, and I was seized by still greater anxiety. I went to Voloshko in the gorispolkom, to Gamanyuk in the party gorkom. Finally, after inquiring of many people, I learned that he was at the medical unit. I rushed over there. But they would not let me in. They said he was receiving an intravenous injection at the time. I did not leave, I went up to the window of his ward. Soon he came to the window. His face was reddish brown. When he saw me, he began to laugh, he was overexcited, he reassured me, asked me about the boys through the glass. It seemed to me that at that point he was somehow particularly glad that he had the sons. He said that I should not let them go into the street. He was even cheerful, and I felt a bit reassured."

Testimony of Gennadiy Nikolayevich Petrov, former chief of the equipment department of Yuzhatomenergomontazh:

"I woke up about 1000 hours on 26 April. A day like any other. Warm sunbeams on the floor, a blue sky through the windows. I was feeling good, I had come home, I would rest. I went on the balcony to have a smoke. The street was already full of children. The little ones were playing in the sand, building sand castles, making mudpies. Those a bit older were racing their bikes. Young mothers were strolling with baby carriages. Life as ordinary as can be. And suddenly I recalled the night, when I had gone up to the unit. I felt anxiety and fear. Now, I remembered my perplexity as well. How could it happen? Everything was as usual and at the same time— everything was horribly radioactive. The inner abhorrence of the invisible filth was delayed because life was normal. The eyes saw that everything was clean, but in fact everything was dirty. It did not make sense.

"By lunchtime, the mood was gay. There began to be an acrid smell in the air. Something metallic, but not metallic, in the air, and something acrid, and a sour taste in the mouth next to the teeth, like when you test a weak flashlight battery with your tongue....

"Our neighbor Mikhail Vasilyevich Metelev, an electrician with GEM, climbed up to the roof about 1100 hours and lay there in bathing trunks to get a suntan. Later on, he came down once to get something to drink, and he said that his tan looked great today, better than ever before. He said his skin immediately gave off a burned smell. And he was in very high spirits, as though he had had too much to drink. He invited me, but I did not go. There was no need to go to the beach, he said. And the burning of the reactor was quite visible, distinct against the background of the blue sky.

"And in the air at that time, as I later learned, there were already about 1,000 millirems per hour. Plutonium, cesium, and strontium. And, of course, iodine-131, above all, was packed tight in the thyroid by evening. In everyone—the children, the adults....

"But at that time we knew nothing. We were living an ordinary human life, and I now realize how cheerful it was.

"Toward evening, the neighbor who had sunned himself on the roof began to vomit intensely, and they took him off to the medical station. And then it seems to Moscow. Or to Kiev. I do not know exactly. But that was perceived as something separate. Because it was an ordinary summer day, the sun, the blue sky, the warm weather. It would happen that way: someone would get sick, the ambulance would take someone away....

"And so it was an ordinary day in every way. Only later, when they had told the whole story, did I recall that night when I had gone up to the unit. I remembered the rut in the road in the light of the headlights, the cement plant covered with cement dust. It stuck in my mind for some reason. And I thought: strange, even that rut was radioactive—just an ordinary rut, and that entire cement plant, and absolutely everything—the sky, the moon, the blood, the brain, and people's thoughts. Everything...."

Testimony of L.A. Kharitonova:

"Even on 26 April, in the afternoon, some people, in particular the children in

school, had been cautioned not to leave the house. But most paid no attention to that. As evening drew closer, it became clear that there was reason for alarm. People dropped in on each other, they shared their fears. They talked, some decontaminated themselves with alcohol, since there was nothing else. I do not know, I did not see it. But Pripyat was very lively, it was seething with people, as though they were preparing for some kind of immense carnival. Of course, the May Day holidays were just ahead. But people's overexcitement was striking...."

At that time, the members of the government commission were preparing to take off from Bykovo Airport in Moscow. That flight included the following: Yu.N. Shadrin, senior assistant to the general procurator; A.I. Mayorets, USSR minister of power and electrification; V.V. Maryin, head of the sector for the nuclear power industry of the CPSU Central Committee; A.N. Semenov, deputy power minister; A.G. Meshkov, first deputy minister of medium machinebuilding; M.S. Tsvirko, chief of Soyuzatomenergostroy; V.A. Shevelkin, deputy chief of Soyuzenergomontazh; L.P Drach, Shcherbina's consultant; Ye. I. Vorobyev, deputy USSR minister of health; V.D. Turovskiy, representative of USSR Minzdrav, and others. In the cabin of the YaK-40, they sat facing one another on red sofas. Maryin shared his thoughts with the members of the commission:

"The main thing that has encouraged me is that the nuclear reactor stood up! Thanks to Dollezhal! Bryukhanov awakened me with a telephone call at 0300 hours and said: A terrible accident, but the reactor is intact. We are constantly feeding cooling water...."

"I think, Vladimir Vasilyevich," Mayorets entered the discussion, "that we will be staying in Pripyat a long time."

Mayorets repeated this 1.5 hours later in the AN-2 airplane which carried the members of the commission from the Zhulyana Airport to Pripyat. V.F. Sklyarov, UkSSR power minister, joined them on the flight from Kiev; he said:

"I think we will get by with 2 days...."

"Do not frighten us, Comrade Sklyarov. Our main task and yours is to restore the damaged unit as quickly as possible and connect it back to the power system."

At approximately this same time, the personal plane of B.Ye. Shcherbina, deputy chairman of the USSR Council of Ministers, was in flight from Barnaul to Moscow. When he landed in the capital, the deputy minister changed clothes,

took a bite, and flew from Vnukovo Airport to Kiev. He would arrive in Pripyat by 2100 hours.

Testimony of G.A. Shasharin:

"On the way from Kiev to Pripyat, I told Mayorets about the working groups. I had thought about this earlier, during the flight from Simferopol to Kiev. Here is the list of groups which I proposed:

"1) a group to study the causes of the accident and the plant's safety—Shasharin and Meshkov responsible;

"2) a group to study the radiation situation around the nuclear plant—Abagyan, Vorobyev, and Turovskiy responsible;

"3) a group to repair the damage and restore operations—Semenov, Tsvirko, and installation people responsible;

"4) a group to evaluate the need to evacuate the population of Pripyat and nearby farms and villages— Shasharin, Sidorenko, and Legasov responsible;

"5) a group to provide instruments, equipment, and supplies—Glavenergokomplekt and Glavsnab responsible.

"We landed at the little airport between Pripyat and Chernobyl. Cars were already waiting there. V.T. Kizima had also come in his GAZ. Maryin and I got in the GAZ (Kizima was driving) and asked him to take us over to the damaged unit. Mayorets was also rushing there, but we talked him out of it, and he went with the official group to the CPSU gorkom.

"We bypassed the police lines and turned toward the industrial area...."

I will interrupt G.A. Shasharin in order to say a few words about V.V. Maryin, CPSU Central Committee sector head.

Vladimir Vasilyevich Maryin is a construction engineer specializing in electric power plants by education and experience. He worked for a long time as chief engineer of the construction and installation trust in Voronezh, and he took part in building the Novovoronezh Nuclear Power Plant. In 1969, he was summoned to the machinebuilding department of the CPSU Central Committee as an

instructor of the Central Committee on power engineering. I saw him rather frequently at Minenergo collegiums, party meetings, in critical inquiries into the work of nuclear power engineers in the associations and main administrations. Maryin had taken an active part in the work of staff headquarters for starting up nuclear plants, he personally knew the heads of the construction administrations of all the nuclear plants, and directly, bypassing USSR Minenergo, he effectively helped the construction projects to get equipment, materials, and labor resources.

Personally. I had always liked this large, red-haired, very shortsighted man with the booming voice and flashing horn-rimmed glasses with the thick lenses because of his directness and clarity of thought. He was industrious and dynamic and was constantly improving his qualifications as an engineer. For all that, Maryin was above all a builder and did not understand operation of nuclear power plants. At the end of the seventies, when I was working as sector chief in the VPO Soyuzatomenergo, I often went to his office in the Central Committee, where at the time he was the only one on that staff concerned with the nuclear power industry. In discussing things, he would usually indulge in digressions, and he would complain of being overloaded: "You have 10 men in your section, and the country's entire nuclear power industry depends on me alone...." And he asked me: "Give me some speedy help, supply me with materials and information...."

At the beginning of the eighties, the nuclear power industry sector was organized in the Central Committee, Maryin headed it, and then finally he had assistants. G.A. Shasharin, an experienced nuclear engineer who had worked for many years operating nuclear power plants and would in future be deputy minister of power for the operation of nuclear plants, became one of them. It was with him that Maryin was at that point riding to the damaged unit in Kizima's GAZ automobile.

On the way, they met buses and private automobiles. The spontaneous evacuation had begun. Some had left Pripyat forever even during the day on 26 April with their families and radioactive belongings, without waiting for the orders of the local authorities.

Testimony of G.A. Shasharin:

"Kizima drove us to the back of Unit 4. He had already been there more than once since the morning. We, of course, had no dosimeters at all. Graphite and

fragments of fuel were scattered around. We could see the drum separators, moved from their footings, glistening in the sun. Above the floor of the central hall, a fiery halo seemed to be visible around the reactor, like the solar corona. A light black smoke was wisping up from the corona. We thought at the time that this was something on the floor burning. Maryin was in a livid rage, he was cursing, he kicked a graphite block in his anger. The emergency tank of the safety control system, crushed in half, was quite visible, making it clear to me that it had not exploded. The fearless Kizima walked around and grieved like the owner that so you would build, he said, you would build, and now you walk over the destroyed fruits of your labor. Since the morning, he had been here several times already, he said, in order to be sure that all this was not a mirage.

"We bypassed the plant and went into the shelter. Prushinskiy, Ryazantsev, and Fomin were there with Bryukhanov. Bryukhanov's motions were slowed down. He was gazing somewhere out ahead of him, apathy. But he carried out orders rather efficiently and straightforwardly. Fomin, by contrast, was overexcited, his eyes were inflamed, they had a glint of madness. Then, there would be a break, severe depression. In a call from Kiev, I had asked Bryukhanov and Fomin whether the pipelines were intact? They assured me that they were intact. It occurred to me at the time to feed boric acid solution to the reactor. I talked to the supply people in Kiev, they found several tons of boric acid and promised to deliver it to Pripyat by evening. But by evening, it had become clear that all the pipelines from the reactor had been torn away and the acid was not necessary. But that would be understood only toward evening...."

Testimony of Vladimir Nikolayevich Shishkin, deputy chief of Soyuzelektromontazh of USSR Minenergo, a participant in the conference in the Pripyat CPSU Gorkom on 26 April 1986:

"We all assembled in the office of A.S. Gamanyuk, gorkom first secretary. G.A. Shasharin was the first to report. He was already reporting that the reactor was destroyed, that he had seen graphite on the ground, pieces of fuel, but I did not have the strength to take this in. In any case, it certainly was sudden. It seemed that the soul and mind needed as it were a smooth inner transition to arrive at that horrible and truly catastrophic reality.

"'We need a collective assessment,' Shasharin said. 'Unit 4 is without power. The transformers were shut off to avoid short circuits. Water has been poured onto all the between-story cableways. Because of the soaking of the switch boxes at the

minus levels, the electricians were told to find 700 meters of power cable and keep it in readiness....'

'"What kind of a plan is that?!' Mayorets said indignantly. 'Why were the utility mains not cut off as planned?'

'"Anatoliy Ivanovich, I am stating a fact. Why is another question. In any case, they're hunting for the cable, water is being fed to the reactor, utility mains are being cut off. It seems the radioactivity is high everywhere around Unit 4.'

'"Anatoliy Ivanovich!' Maryin interrupted Shasharin in his booming bass. 'I have just gone past Unit 4 with Gennadiy Aleksandrovich. It is a horrible scene. It is incredible to think what we have come to. There is the smeli of fire fumes, and graphite is scattered around. I even kicked a graphite block to make certain that it was real. Where does the graphite come from? All that graphite?'

'"Bryukhanov!' the minister turned to the nuclear power plant director. 'You reported that the radiation situation is normal. What about the graphite?'

'"It is difficult even to imagine.... The graphite which we received for the fifth power-generating unit, which is under construction, is intact, all in its place. I first thought that it was that graphite, but it is still in place. In that case, it is not precluded that the reactor erupted.... Partially. But then....'

'"No one has managed to measure the radioactivity accurately,' Shasharin explained. 'We suppose that the background is very high. There was one radiometer here, but it was buried in the rubble.'

'"Disgraceful! Why did the plant not have the necessary instruments?'

'"An accident occurred that was not envisaged in the design. The unthinkable happened.... We called for help from the country's civil defense and chemical forces. They will soon arrive.'

"It seemed that all those responsible for the catastrophe wanted one thing—to postpone the moment of full recognition, when all the i's would be dotted. They wanted, as was customarily done before Chernobyl, for responsibility and blame to be spread ever so quietly over everyone. That was the reason for this procrastination when every minute was precious, when delay threatened the city's innocent population with irradiation. When it was already in everyone's

mind, the word 'evacuation' was beating against people's skulls....

"But the reactor was burning all that time. The graphite was burning, spewing millions of curies of radioactivity into the sky.

"'In spite of the problematical and even grave situation at the damaged unit, the situation in Pripyat is businesslike and calm,' Gamanyuk, first secretary of the Pripyat Party Gorkom, reported to Mayorets (at the time of the accident he was in the medical unit for an examination, but on the morning of 26 April he left his hospital bed and went to work). 'No panic or disorder. Normal, ordinary life on a day off. Children are playing in the streets, athletic competitions are taking place, classes in the schools. Even weddings are being celebrated. Today, they have celebrated 16 weddings of Komsomol young people. We put a stop to false rumors and loose talk.

There have been casualties in the damaged unit. Two operators—Valeriy Khodemchuk and Vladimir Shashenok have died. Twelve persons were sent to the medical unit in a serious condition. Another 40 people, less serious, were hospitalized later. Casualties are continuing to arrive.'

"Gennadiy Vasilyevich Bedrov, tall, gray-haired, and calm, MVD major general, UkSSR deputy minister of internal affairs, came to Pripyat at 0500 hours on 26 April in a new uniform he had recently had made. Gold shoulder straps, a mosaic of medal ribbons, the badge of a distinguished officer of the USSR MVD. But his uniform and gray hair were already terribly dirty, radioactive, since the general had spent all the morning hours right alongside the nuclear power plant. The hair and clothing of all those present were radioactive now, including those of Mayorets, the minister. Radiation, like death, does not sort out who you are—a minister or an ordinary mortal.

"'Anatoliy Ivanovich,' General Bedrov reported, 'at 0500 hours, I was in the area of the damaged powergenerating unit. Police details took the baton from the firemen. They cut off all the roads to the plant, to the settlement, and especially the fishing spot at the reservoir of the cooling pond. (We should note here that General Bedrov, guessing the danger, had not imagined what it really was, so that his policemen were without dosimeters and personal safety equipment, and they were all overirradiated to the last man. But they instinctively acted correctly—they sharply curtailed access to the zone assumed to be dangerous.—G.M.) An operations command staff was formed and was operating in the Pripyat

police station. Staff members of the Polesskiy, Ivanovskiy, and Chernobylskiy Rayon sections had come to help. By 0700 hours, there were more than 1,000 MVD personnel in the disaster area. Details of transport police were reinforced at the Yanov Railroad Station. Freight trains with very valuable equipment were there at the moment of the explosion. Passenger trains have been arriving. Locomotive crews and passengers know nothing about what has happened. It is summer now, the windows of the cars are open, the railroad passes within 500 meters of the damaged unit. The train traffic has to be stopped. (We would like to praise General Bedrov once again. Of all those at the meeting, he was the first to evaluate the situation correctly.—G.M.) The posts are being manned not only by sergeants and sergeant-majors, but even by police colonels. I am assigning the posts in the danger zone personally. There has not been a single refusal to serve. The bus companies in Kiev have made a great effort. In case of evacuation of the population, 1,100 buses have been driven to Chernobyl and wait for instructions from the government commission....'

"'Why are you telling me all this about evacuation?!' the minister erupted. 'Do you want to cause a panic? The reactor has to be shut down and everything stopped. The radiation will return to normal. What about the reactor, Comrade Shasharin?'

"'The operators, according to the data of Fomin and Bryukhanov, shut it down by pressing the AZ-5 button.' Shasharin was entitled to speak that way; after all, he still had not been up in the air....

"'And where are the operators? Can they be summoned?' the minister insisted.

"'The operators are in the medical unit, Anatoliy Ivanovich.... In a very serious condition.'

"'I proposed evacuation early this morning,' Bryukhanov said dully. 'I asked Moscow, Comrade Drach. But they told me to do nothing along those lines until Shcherbina arrived. And not allow panic.'

"'What does civil defense say?'

"Solovyev stood up, that same civil defense chief of the nuclear power plant, who in the first 2 hours after the explosion determined a dangerous degree of radiation by means of the only radiometer with a scale that went up to 250 roentgens. (The reader knows Bryukhanov's reaction. But this should be added:

During the night, Solovyev sent a separate distress signal to the republic's civil defense, for which he deserves every praise.)

"in the range of 250 roentgens off the scale in the areas of the pile of debris, the turbine hall, the central hall, and other places around and within the unit. Immediate evacuation is necessary, Anatoliy Ivanovich.'

"Turovskiy, representative of USSR Minzdrav, said: 'I believe evacuation is absolutely necessary. From what we have seen in the medical unit...I am referring to the examination of patients...they are in a serious condition. The doses, according to the first superficial assessments, exceed lethal doses by a factor of between 3 and 5. Indisputable diffusion of radioactivity over great distances from the power-generating unit.'

"'But if you are wrong?' Mayorets asked, restraining his dissatisfaction. 'We will analyze the situation and make a decision. But I am against evacuation. The danger is clearly being exaggerated.'

"They announced an intermission."

Testimony of B.Ya. Prushinskiy, chief engineer of the VPO Soyuzatomenergo:

"When we returned to the city committee headquarters with Kosta Polushkin, Shasharin and Mayorets were standing in the hall smoking. We came up and right there in the hall reported to the minister the results of our examination of Unit 4 from the air: It can be assumed that the reactor has been destroyed. The cooling is ineffective.

"'The reactor has a lid,' Polushkin said.

"Inhaling deeply, in puffs of smoke, frail anyway and in collegium meetings seeming like a plaything by comparison with heavyweights like deputy minister Semenov, Shasharin now looked even more haggard and pale, his usually smooth chestnut-colored hair had tufts protruding, his pale blue eyes were looking without blinking behind the enormous lenses of the imported spectacles. At that point, we were all poisoned and killed. Except for Mayorets probably. As always, he was neat, with an even pink part in his hair, nothing to be seen in his face.

'"What do you propose?' Mayorets asked.

'"Damned if I know, it is difficult to understand all at once. The graphite is burning in the reactor. It has to be extinguished. That is the very first thing. But how, with what...we will have to think.'

"We all went into Gamanyuk's office. Shasharin began to read the lists of working groups. When it came to the recovery operations, the representative of the general designer shouted from his seat:

'"It is not recovery we need, but burial!'

'"Don't get off the subject, Comrade Konviz!' Mayorets interrupted him. 'Within the hour, the groups are to prepare measures for a report to Shcherbina. He should arrive any time....'"

Testimony of G.A. Shasharin:

"Later, we went up in the helicopter with Maryin and the deputy chairman of Gosatomenergonadzor and Sidorenko, corresponding member of the USSR Academy of Sciences. We hovered over the unit at an altitude of 250 to 300 meters. It seems the pilot had a dosimeter. Although no radiometer. At that altitude, the radiation was 300 roentgens per hour. The upper slab had been heated to a bright yellow color by contrast with the bright cherry color reported by Prushinskiy. Which meant that the temperature in the reactor had risen. The slab was not as crooked where it lay on the shaft as later, when they threw in the bags of sand. The weight slewed it around. At this point, it had finally become clear that the reactor was destroyed. Sidorenko proposed throwing about 40 tons of lead into the reactor in order to reduce the radiation. I was categorically opposed. That kind of weight from an altitude of 200 meters was an immense dynamic load. It would make a hole all the way through, right down to the bubbler pond, and the entire melted core would flow down into the water of the pond. Then you would have to run wherever your legs would take you.

"When Shcherbina arrived, I went to him before the conference and said that the city had to be evacuated immediately. He replied that that could cause panic...."

By that time, by approximately 1900 hours, all the stocks of water at the nuclear power plant were at an end. The pumps started up with such an effort by the overirradiated electricians tripped. Radioactivity rose very rapidly everywhere.

The damaged reactor continued to belch millions of curies of radioactivity from its glowing throat. In the air, there was the entire range of radioactive isotopes, including plutonium, americium, and curium. All of these isotopes were incorporated (penetrated) into people's organisms, both those who were working at the nuclear power plant and also the inhabitants of Pripyat. During 26 and 27 April, right up until the evacuation, radionuclides continued to be accumulated, and in addition, people were exposed to external gamma and beta irradiation.

At the Pripyat City Medical Unit

The first group of casualties, as we already know, were transported to the medical unit some 30 to 40 minutes after the explosion. A particularly difficult feature of the nuclear disaster at Chernobyl was that the effect of radiation on the human organism was combined: powerful external and internal irradiation, compounded by thermal burns and the wetting of the skin. The pattern of the actual lesions and doses could not be established immediately because the physicians did not have data on the true radiation fields. And only the primary reactions of the people irradiated: very intense erythema (the nuclear sunburn), edema, burns, nausea, vomiting, weakness, in some a state of shock, indicated the severity of the lesions. What is more, the medical unit serving the Chernobyl Nuclear Power Plant was not equipped with the necessary radiometric apparatus, and the physicians were not trained from the organizational standpoint to receive such patients. The necessary urgent classification of casualties according to the pattern of the course of the disease was not done. In such cases, the main criterion chosen is the probable outcome:

1) recovery impossible or unlikely,

2) recovery possible assuming the use of up-to-date therapeutic means and methods,

3) recovery likely,

4) recovery guaranteed.

This classification is particularly important when a large number of people have been irradiated and there is a need for rapid determination of whose life can be saved by aid rendered promptly. It is especially important here to know when the irradiation began, how long it lasted, whether the skin was dry or wet (radionuclides diffuse within more intensively through wet skin, especially skin

that has been injured by burns and wounds).

The casualties were not classified with respect to the pattern of acute radiation sickness, and their contact with one another was unrestricted. Sufficient decontamination of the skin was not provided for (only a washing off under the shower, which was ineffective or little effective because of diffusion of radionuclides and accumulation in the grainy layer under the epidermis).

Principal attention was paid to treating patients in the first group with very severe primary reactions, who were immediately given intravenous injections, and patients with very severe thermal burns (the firemen, Shashenok and Kurguz).

It was only 14 hours after the accident that a plane brought a specialized team from Moscow consisting of physicists, therapeutic radiologists, and hematologists. One to three blood analyses were performed, outpatient cards were filled out with entries indicating clinical manifestations after the accident, patients' complaints, the number of leukocytes and the leukocyte distribution....

Testimony of V.G. Smagin (who took over the shift from Akimov):

"They sat the five of us down in the ambulance and took us off to the medical unit in Pripyat. They used the RUP (instrument for measuring radioactivity) to measure everyone's radioactivity. We washed several times. We were still radioactive. There were several therapeutists in the room for physicians; Lyudmila Ivanovna Prilepskaya immediately took me off to her office, her husband was also a unit shift chief, and our families were friendly. But at this point, the other lads and I began vomiting. We saw a bucket or a wastebasket, we took it and three of us at once began to vomit into that bucket.

"Prilepskaya asked where I had been in the unit and what the radiation fields were there? She simply could not understand that there were fields there everywhere, that it was dirty everywhere. The entire nuclear plant was an unbroken radiation field. I told her what I could between bouts of vomiting. I said that none of us knew exactly what the fields were. They were off scale at 1,000 microroentgens per second, and that was all.

"They put the IV needle in my vein. After about 2 hours, I began to feel vigor in my body. When the IV was finished, I stood up and began to look for a smoke. There were two others there in the ward. On one bed, a guard who was an

ensign. He kept saying: 'I am going to get away from here and go home. My wife and children are worried. They do not know where I am. And I do not know what has happened to them.' 'Just lie still,' I told him. 'You have taken rems, now get your treatment....'

"On the other bed was a young adjuster from the Chernobyl startup and adjustment enterprise. When he learned that Volodya Shashenok had died in the morning, it seems at 0600 hours, then he began to shout why had they concealed it from him that he was dead, why hadn't they told him? He was hysterical. And he seemed to have taken fright. If Shashenok had died, that meant that he could also die. He shouted out loud: 'They are concealing everything, hiding everything...! Why didn't they tell me?!' Then he calmed down, but then he was seized with an exhausting bout of hiccuping.

"It was 'dirty' in the medical unit. The instrument showed radioactivity. They had mobilized women from Yuzhatomenergomontazh. They were constantly washing the floors in the corridor and in the wards. The dosimetrist would come and measure everything. He kept muttering all the time: 'They wash and they wash, but it is still dirty....'

"I heard my name being called through the open window. I looked, and down below was Serezha Kamyshnyy from my shift. He was asking: 'So, how are things?' And I answered him with: 'Have you got a smoke?' They dropped down a string and brought the cigarettes back up on the string. I told him: 'And you, Serega, what are you doing wandering around? You picked it up, too. Come in with us.' 'But I feel normal. I just decontaminated myself.' He pulled a bottle of vodka from his pocket. 'Do you need some?' 'Oh, no! They have already poured it into me....'

"I stopped in the ward where Lena Toptunov was. He was lying there. All reddish brown. His mouth and lips were very swollen. So was his tongue. It was difficult for him to speak. One thing was torturing everyone: Why had it exploded? I asked him about the reactivity margin. Speaking with difficulty, he said that 'Skala' showed 18 rods. But it could have been wrong. The computer was sometimes wrong....

"Volodya Shashenok died from burns and radiation at 0600 hours. It seems they had already buried him in a village cemetery. But Aleksandr Lelechenko, deputy chief of the electric shop, had felt so good after the IV that he had run out of the

medical unit and gone back to the plant again. The second time they had already taken him off to Kiev in a very serious condition. He died there in terrible pain. The total dose he received was 2,500 roentgens. Neither intensive therapy nor bone marrow transplant could help him....

"Many felt better after the IV. I met Proskuryakov and Kudryavtsev in the corridor. They were both holding their arms pressed against their chest. Their arms had remained in the bent position the way they had shielded themselves from the radiation of the reactor in the central hall, and they could not straighten them out, and the pain was terrible.

"Valera Perevozchenko did not get up after the IV. He lay there in silence, turned to the wall. Tolya Kurguz was covered all over with burn blisters. In some places, the skin was broken and was hanging off in tatters. His face and hands were severely swollen and covered with scabs. The scabs would break with every movement of the muscles. And the pain that was wasting him. He complained that his entire body had become an unrelenting pain. Petya Palamarchuk, who had carried Volodya Shashenok out of the nuclear hell, was in the same condition.

"The physicians had, of course, become irradiated themselves. The atmosphere and the air in the medical unit were radioactive. The seriously ill were also radiating intensely; after all, they had inhaled the radionuclides and absorbed them into their skin.

"There has been nothing like it anywhere in the world. We were the first after Hiroshima and Nagasaki. But there is nothing to be proud of here....

"Everyone who felt better collected in the smoking room. They were thinking about one thing: Why had it exploded? Sasha Akimov was also there, mournful and severely 'sunburned.' Anatoliy Stepanovich Dyatlov came in. He was smoking and thinking. The way he usually was. Someone asked him: 'How much did you take in, Stepanych?' 'W-well, I think, 40 r-roentgens.... We will live....'

"He was wrong by exactly a factor of 10. In Moscow's Clinic No 6, they read him at 400 roentgens. Thirddegree acute radiation sickness. And he had scorched his feet and legs plenty when he walked through the fuel and graphite around the unit.

"The word 'sabotage' was sticking in many people's minds. Because when you

cannot explain things, you think of the devil himself. Akimov had one answer to my question: 'We did everything correctly.... I do not understand why it happened....' Dyatlov was also convinced of the correctness of his actions.

"The team of physicians from Moscow Clinic No 6 had arrived by evening. They walked through the wards. They examined us. Georgiy Dmitriyevich Selidovkin, a doctor with a beard, selected the first group—28 people—to be sent to Moscow at once. He made the selection on the basis of the nuclear sunburn. He was not interested in analyses. Almost all 28 would die....

"The damaged unit was quite visible through the window. The graphite burned into the night. The gigantic flame curled around the ventilation stack. It was terrible to look at. They put 26 people in a red Ikarus bus. They took Kurguz and Palamarchuk off in the ambulance. They took off from Borispol about 0300 hours. They sent the rest who were a bit better, including me, to Clinic No 6 in Moscow on 27 April. We went in three Ikarus buses. Screams and tears during the trip. We all went without changing clothes, in the striped hospital clothing.

"In Clinic No 6, they determined that I had taken 280 rads...."

About 2100 hours on 26 April 1986, Boris Yevdokimovich Shcherbina, deputy chairman of the USSR Council of Ministers, arrived in Pripyat. He had become the first chairman of the government commission to prepare the damage of the nuclear disaster at Chernobyl. Paler than usual, with his lips pressed tightly and the imperious look of the deep folds in his lean cheeks, he was calm, collected, and concentrated.

At that point, he still did not realize that around, both on the street and indoors, the air was saturated with radioactivity, was emitting gamma and beta rays, absolutely indifferent as to who was irradiated—the devil's own, ministers, or ordinary mortals.

He was endowed with immense power, but he was a human being, and it took the course with him that it takes in a human being: first, the storm would build underneath against the background of external calm, and then, when he had figured something out and was outlining the strategies, the real storm would burst out, a vicious storm of haste and impatience: faster, faster! Come on, come on!

But a cosmic tragedy was taking place at Chernobyl. And the cosmos has to be

crushed not only with cosmic force, but also with the depth of reason, which is also the cosmos, just that it is alive and presumably more powerful.

Mayorets was forced to admit that Unit 4 had been destroyed. That the reactor had also been destroyed. The unit had to be covered (buried). More than 200,000 m3 of concrete would have to be packed into the interior of the unit destroyed by the explosion. It seemed the thing to do was to make metal boxes, encase the unit in them, and then cover them with concrete. It was not clear what should be done with the reactor. It was glowing. Thought had to be given to evacuation.

"Don't be in a hurry with the evacuation," Shcherbina said calmly, but it was obvious that the calm was forced. Ah, how everyone would have liked for there to be no evacuation! After all, so far the new ministry had had a good beginning. They had increased the coefficient of installed capacity, and the frequency had been stabilized in power systems.... And now....

When he had heard everyone, Shcherbina invited those present to take part in a collective reflection: "Think, comrades, make proposals. At this point, we need a brainstorm. I do not believe that it would be impossible to extinguish the reactor. Gas wells have been extinguished, it was not this kind of fire, a firestorm. But they did put them out!"

And it began. Everyone presented what came into his head. That is the point of the brainstorming method: even some nonsense, random talk, heresy, might unexpectedly suggest a serious idea. All manner of things were proposed: even lifting an immense tank of water by helicopter and pouring that tank on the reactor and making a kind of nuclear Trojan horse in the form of an immense hollow concrete block. Put people inside and move this block to the reactor, and when you are quite close, then throw something to cover the reactor itself.... Someone seriously asked: "But how are you going to move this cumbersome thing, this what do you call it, Trojan horse? You need wheels and a motor...." The idea was immediately discarded.

Shcherbina himself expressed an idea. He proposed sending fireboats up the intake channel which ran alongside the unit and pouring water on the burning reactor from there. One of the physicists explained that you could not put out a nuclear fire with water, the radioactivity would rage still more. The water would evaporate, and the steam would cover everything around with fuel. The idea of the fireboats was also discarded.

Finally, someone mentioned that fire, including a nuclear fire, can be safely extinguished with sand. Seal it up tight. From above. There was no other direction from which you could get to the reactor.

And at this point it became clear that it could not be done without aircraft. They sent an urgent request to Kiev for helicopter pilots.

Major General N.T. Antoshkin, deputy Air Force commander of the Kiev Military District, was already on his way to Chernobyl. Meanwhile, the government commission was deciding the issue of the evacuation. The civil defense and medical people from USSR Minzdrav were especially insistent on it.

"Evacuation is necessary at once!" Vorobyev, deputy health minister, argued fervently. "There is plutonium, cesium, strontium...in the air. The condition of the casualties in the medical unit indicates very intense radiation fields. The thyroid glands of people, including children, have been larded with radioactive iodine. No one is doing prevention with potassium iodide.... Incredible...!"

Shcherbina summed up: "We are evacuating the city on the morning of 27 April. Bring up all 1,100 buses during the night to the highway between Chernobyl and Pripyat. You, General Bedrov, please set up sentries at every house. Let no one in the street. In the morning, civil defense will announce the necessary information to the population over the radio. And also state the exact time of the evacuation. Carry potassium iodide tablets around to people at home. Enlist Komsomol members for that purpose."

Shcherbina, Shasharin, and Legasov took a helicopter up into the radioactive nighttime sky of Pripyat and hovered over the damaged unit. Shcherbina looked through the binoculars at the reactor, which had been heated to a bright yellow glow against which the dark smoke and tongues of flame were clearly visible. And in the cracks on the right and left, in the bowels of the destroyed core, the light was a twinkling starry blue. It was as though someone omnipotent had set up an immense invisible bellows and was supplying a blast to this gigantic nuclear hearth, which was 20 meters in diameter. He looked with respect on this immense nuclear monster, which undoubtedly possessed more power than even the deputy chairman of the USSR Council of Ministers. "Just see how it flared up! And how much sand has to be thrown into that crater," Shcherbina pronounced the letter "e" in the word "crater" as a very soft vowel. "Fully assembled and loaded with fuel, the reactor weighs 10,000 tons," Shasharin

explained. "If half of the graphite and fuel have been disgorged, that would be about 1,000 tons, and a pit would be formed 4 meters deep and 20 meters in diameter. Sand has a higher density than graphite. I think 3,000 or 4,000 tons of sand will have to be dropped." "The helicopter pilots will have to do a job. What is the radioactivity at an altitude of 250 meters?" "Three hundred roentgens per hour. But when the load comes down on the reactor, this will raise nuclear dust, and the radioactivity at that altitude will rise sharply. And the bombing will have to be done from a lower altitude...."

The helicopter slipped away from the crater.

Shcherbina was comparatively calm. His calm was explained not only by the deputy minister's self-control, but also to a considerable extent by his being incompletely informed about nuclear details and also by the indefiniteness of the situation. In just a few hours, when the first decisions had been made, he would begin to put pressure on his subordinates, to be in a hurry, issuing accusations of slowness and every mortal sin there is....

5

27 April 1986

Long after midnight on 27 April, Maj Gen Antoshkin called the first pair of helicopters by walkie-talkie. But they could not come down in that situation without someone on the ground to guide them. Antoshkin rushed to the roof of the 10-story "Pripyat" Hotel with his walkie-talkie and became the guide for the flight. Unit 4, which the explosion had ravaged, was visible as in the palm of his hand with the corona of flame over the reactor. Further to the right, beyond the Yanov Station and overpass was the highway to Chernobyl, and on it the endless column of empty buses of various colors hiding in the distant morning haze: red, green, blue, and yellow, standing still, waiting for orders. Eleven hundred buses were stretched along the entire road from Pripyat to Chernobyl, which is 20 km. The picture of this convoy standing still on the highway was oppressive.

At 1330 hours, the convoy started up, moved, crawled over the overpass, and broke up into separate vehicles at the entrances of the snow-white apartment buildings. And then, leaving Pripyat, taking people away forever, they carried away on their wheels millions of particles of radioactivity, contaminating the roads of settlements and cities....

Provision should have been made to change the wheels when they left the 10-km zone. But no one thought about that. The radioactivity of the asphalt in Kiev will have between 10 and 30 millirems per hour for a long time yet, and the roads will have to be washed for months.

Testimony of I.P. Tsechelskaya, operative in the Pripyat concrete-mixing unit:

"I and others were told that the evacuation would be for 3 days and that we should not take anything. I went off in just my dressing gown. I only grabbed up my passport and a little money, which soon ran out. They did not let us go back after 3 days. I arrived in Lvov. No money. Had I known, I would have taken along my savings book. But I left everything. The stamp showing that I was registered in Pripyat had no effect on anyone. I asked for help. They did not give it. I wrote a letter to Mayorets, the power minister. I do not know, surely my dressing gown and everything I had on was very 'dirty.' They did not take a

reading of me...."

The minister's visa on Tsechelskaya's letter reads:

"'Allow Comrade I.P. Tsechelskaya to apply to any organization of USSR Minenergo. They will give her 250 rubles.' But that visa was dated 10 July 1986. And this was 27 April...."

Testimony of G.N. Petrov:

"At exactly 1400 hours, the buses came to every entrance. They cautioned us once again over the radio: dress lightly, take a minimum of things, we would be coming back in 3 days. Even then, the involuntary thought flickered: if many things were taken, then even 1,000 buses would not be enough.

"Most people obeyed and did not even take what money they had. But in general our people are good: they joked, they cheered up each other, they reassured the children. They would say to them: we are going to see grandma...to the film festival...to the circus.... The adults and the children were pale, sad, and silent. Forced cheerfulness and anxiety were in the air together with the radiation. But it was all efficient. Many people had gone downstairs ahead of time and crowded outside with their children. They kept asking them to go back inside the entrance. When they announced the boarding, we went out of the entrance and right into the bus. Those who lingered behind ran from bus to bus, simply taking unnecessary rems. And so, in a day of peaceful, ordinary life, we had taken more than enough both outside and inside.

"We drove to Ivankov (60 km from Pripyat) and there were scattered among the villages. Not everyone took us in willingly. One well-off peasant would not let my family into his immense brick house, not because of the dangerous radiation (he did not understand about that, and explanations had no effect on him), but out of greed. He had not built it, he said, to let strangers in....

"Many who had left the buses in Ivankov went on further toward Kiev by foot. Some hitched rides. A helicopter pilot I knew told me only later what he had seen from the air: huge crowds of lightly dressed people, women with children, elderly people, going along the road and the shoulders toward Kiev. He had seen them even in the area of Irpen and Brovary. The vehicles were stuck in those crowds, just as they would have been in a cattle drive. You often see something like that in the films in Central Asia, and you immediately think of a

comparison, even if a bad one. And the people trudging, trudging, trudging...."

It was tragic for the travelers to leave behind their household pets, dogs and cats. The cats, sticking their tails straight up, looked into people's eyes, meowed, dogs of the most diverse breeds howled, made their way into the buses, whined heartrendingly, and snarled when they were dragged away. But it was not possible to take along the cats and dogs, which the children had become particularly accustomed to. Their fur was highly radioactive, just like people's hair. But then animals spend the whole day outside in the street. How much had they collected?

Dogs deserted by their masters ran behind their respective buses for a long time. But in vain. They stayed behind and returned to the abandoned city. And they began to get together in packs.

Archeologists at one time read an interesting inscription on Babylonian clay tablets: "When the dogs form packs in a city, the city will fall and be destroyed." The city of Pripyat has been left abandoned, mothballed by radiation for several decades. A ghost city....

The dogs which had formed into packs first of all gobbled up most of the radioactive cats, then they grew wild and snarled at people. They tried to attack people and abandoned livestock.... A group of hunters with rifles was urgently assembled, and in the course of 3 days they shot all the radioactive dogs that had gone wild, among them mongrels, mastiffs, sheep dogs, terriers, spaniels, bulldogs, poodles, and lapdogs. The shooting was completed on 29 April, and the corpses of dogs of different colors were scattered over the streets of abandoned Pripyat....

Inhabitants of villages and farms close to the power plant were also subject to evacuation. In particular, Semikhodov, Kopachey, Shepelichey, and others. Anatoliy Ivanovich Zayats (chief engineer of the trust Yuzhatomenergomontazh) went with a group of helpers, among them hunters with rifles, to make the rounds of the farms and villages and explain that people had to leave their homes. The state would pay them in full for everything. Everything would be fine. But people did not understand, they did not want to understand:

"How is this so?...The sun is shining, the grass is green, everything is flourishing and blossoming. See what gardens there are...."

Many inhabitants, having heard that grass must not be fed to the livestock, drove the cows, sheep, and goats up an inclined ramp to the roofs of barns and kept them there so that they would not go and browse the grass. They thought this was for a short time. A day or 2, and then it would be possible again. It had to be explained to them over and over. They shot the livestock and transported the people to a safe place....

On the morning of 27 April, the first two MI-6 helicopters arrived on Gen Antoshkin's call; they were piloted by the experienced pilots B. Nesterov and A. Serebryakov. The thunder of the helicopter engines when they landed in the square in front of the CPSU city committee awakened all the members of the government commission, who had not lain down for a few hours' nap until 0400 hours.

Nesterov and Serebryakov did a thorough reconnaissance from the air, sketched the diagram of the runs on the reactor to dump the sand. The approaches to the reactor from the air were dangerous, the Unit 4 stack was in the way, it was about 150 meters high. Nesterov and Serebryakov measured the radioactivity at various altitudes over the reactor. They did not drop below 110 meters, since the radioactivity rose sharply. At an altitude of 110 meters, it was 500 roentgens per hour, but after the "bombing" it surely rose even higher. They had to hover over the reactor for 3 or 4 minutes in order to dump the sand. The dose which the pilots received in that time was between 20 and 80 roentgens, depending on the intensity of the radiation background. And how many flights would there be? They would find out today. It was a combat situation in a nuclear war....

The deafening roar hindered the work of the government commission. They had to speak very loudly, to shout. Shcherbina became nervous: "Why not start throwing the bags into the reactor along with the sand?" When the helicopters landed and took off, the whirling propellers blew radioactive dust containing fission products from the surface of the ground. The radioactivity rose sharply in the air near the headquarters of the party gorkom and inside the buildings located nearby. People were suffocating.

And still the damaged reactor was belching and belching millions and millions of curies....

Gen Antoshkin gave up his place on the roof of the "Pripyat" Hotel to Colonel Nesterov so that the latter would guide the flight, and he himself would go up in

the air. For a long time, he could not figure out where the reactor was. If you were not familiar with the unit's structure, it was difficult to get your bearings. He realized that knowledgeable assembly workers or operating personnel had to be taken on the "bomb runs."...

The reconnoitering was done, the flight approaches to the reactor were determined. They needed bags, shovels, sand, and people who would fill the bags and load them into the helicopters. Gen Antoshkin expounded all this to Shcherbina. All of them in the party gorkom were coughing, their throats were dry, they had difficulty speaking.

"You don't have enough people in the military?" Shcherbina inquired. "You are putting those questions to me?"

"The pilots must not load the sand!" the general parried. "They have to fly the planes, man the controls, the run on the reactor must be accurate and guaranteed. Their hands must not shake. They can't be handling bags and shovels!"

"Here, general, take two deputy ministers—Shasharin and Meshkov, let them take care of the loading, provide the bags, shovels, and sand.... Here, there is sand piled all over. The soil is sandy. Find a place nearby that is not paved, and go to it.... Shasharin, recruit assemblers and builders at large. Where is Kizima?"

Testimony of G.A. Shasharin:

"Air Force Gen Antoshkin did very good work. A vigorous and businesslike general, he gave no one any peace and pestered them all. At some 500 meters from the gorkom, near the 'Pripyat' Cafe they found a pile of excellent sand near the river terminal. The hydraulic dredges had built it up for construction of the city's new residential areas. They brought a bundle of bags from the warehouse of the worker supply division, and we, at first three of us—1, A.G. Meshkov, first deputy minister of medium machinebuilding, and Gen Antoshkin—began to fill the bags. We were soon in a sweat. We worked just the way we were: Meshkov and I in Moscow suits and street shoes and the general in his dress uniform. All without respirators and dosimeters.

"I soon involved in this effort Antonshchuk, manager of the trust Yuzhatomenergomontazh, his chief engineer A.I. Zayats, Yu.N. Bypiraylo, administration chief of GEM, and others. Antonshchuk ran up to me with a list of benefits which in this situation I considered comical, but I approved it on the

spot. Antonshchuk and those who were about to go to work were operating according to the old pattern, not understanding that the 'dirty' zone was now everywhere, that benefits would have to be paid to everyone who lived in the city. I did not intend to distract people with explanations. There was a job to be done. But there were not enough people arriving. I asked A.I. Zayats, chief engineer of Yuzhatomenergomontazh, to go to nearby kolkhozes and ask for help...."

Testimony of Anatoliy Ivanovich Zayats:

"Antonshchuk and I went to the farms on the 'Druzhba' Kolkhoz. We went from farm to farm. The people were working in plots around the house. But many were out in the fields. It was spring, planting time. We began to explain that the soil was already unsuitable, that the throat of the reactor had to be plugged up, and that we needed help. It had been very hot since morning. People were in a Sunday, preholiday frame of mind. They had trouble believing us. They went on working. Then we found the kolkhoz chairman and secretary of the party organization. They went into the fields with us. We explained over and over again. Finally, people looked at us with understanding. Some 150 volunteers gathered— men and women. After that, they worked loading the bags into the helicopters without stopping. And it was all done without respirators or other safety devices. On 27 April, they supported 110 helicopter flights, on 28 April, 300 helicopter flights...."

And under the roar of the helicopters Shcherbina was hurrying and driving everyone mercilessly—ministers, deputy ministers, academy members, marshals, and generals: "They know how to explode a reactor, but no one knows how to fill bags with sand!"

Finally, they loaded the first lot of six bags of sand onto the MI-6. Antonshchuk, Deygraf, and Tokarenko took turns going on the bomb runs in the helicopters. They had built that reactor, and they were needed to tell the pilots very precisely when to drop the bags.

Col Nesterov, a first-class military pilot, made the first helicopter bomb run. At a speed of 140 km/hr, they followed a straight line toward Unit 4. The sighting point was to go left of the two 150-meter stacks of the nuclear power plant. They passed over the crater of the nuclear reactor. Altitude 150, no, that was high. One hundred and ten meters. The radiometer showed 500 roentgens per hour. They

hovered over the chink formed by the partly skewed disk of the upper biological shield and the shaft. A chink that was about 5 meters wide. It had to go in. The upper shield was heated to the color of the sun when it looks like a disk in the sky. They opened the door. The heat was carried up from below. A powerful upward flow of radioactive gas ionized by neutrons and gamma rays. It was all without respirators. The helicopter was not shielded with lead on the underside. That was thought of later, when hundreds of tons of the load had already been dropped. But now.... They stuck their heads out the open door and looking down into the nuclear crater, eyeballing it, they would dump the bag. And that went on the whole time. There was no other method.

The first 27 crews and Antonshchuk, Deygraf, and Tokarenko, who helped them, were soon disabled, and they were sent off to Kiev for treatment. Radioactivity at the altitude of 110 meters reached 1,800 roentgens per hour after the bags were dumped. The pilots became sick in the air. After all, the throwing of the bags from such an altitude proved to cause a considerable shock to the glowing core. There was a sharp increase, especially on the first day, of the discharge of fission fragments and radioactive ash from the graphite that was consumed. People were breathing all of that. For a month afterward, they were rinsing uranium and plutonium salts out of the blood of the heroes by replacing their blood over and over.

On the days that followed, the pilots themselves thought about putting lead sheets under their seats and wearing respirators. This measure somewhat reduced the exposure of flight personnel.

At 1900 hours on 27 April, Maj Gen Antoshkin reported to Shcherbina, chairman of the government commission, that 150 tons of sand had been thrown into the crater of the reactor. He said it with some pride. Those 150 tons had not been easy. "Not good, general," Shcherbina said. "One hundred and fifty tons of sand for a reactor like that is like a BB shot to an elephant. We have to pick up the pace sharply." The general was about to drop from fatigue and sleeplessness, and this assessment of Shcherbina's discouraged him. But only for a moment. He plunged back into the fight.

From 1900 to 2100 hours, he worked out relations with all the leaders crucial to supplying the helicopter pilots with bags, sand, and people to do the loading.... He figured how to use a parachute to increase productivity. They would load the bags into the canopy, shape it into a big sack, attach the straps to the helicopter,

and off it would go to the reactor....

On 28 April, 300 tons were dumped.

29 April—750 tons.

30 April—1,500 tons. 1 May—1,900 tons....

At 1900 hours on 1 May, Shcherbina reported the need to cut the dumping in half. The fear had arisen that the concrete structures which the reactor rested on would not hold, and everything would collapse into the bubbler pond. That brought the threat of a thermal explosion and an immense radioactive discharge....

In all, about 5,000 tons of loose materials were dumped into the reactor between 27 April and 2 May....

Testimony of G.A. Shasharin:

"On 26 April, I decided to shut down Units 1 and 2. They began the shutdown at approximately 2100 hours and stopped them somewhere around 0200 hours on 27 April. I ordered that 20 supplemental rods be added uniformly to the core of each reactor by inserting them in the empty channels. If there were no empty channels, pull out the fuel assemblies and put the supplemental rods in their place. This artificially increased the negative reactivity margin.

"At night, Sidorenko, Meshkov, Legasov, and I conjectured about what could have been the cause of the explosion. We were blaming radiolytic hydrogen, but then it occurred to me that the explosion had been in the reactor itself. We also hypothesized sabotage. That explosives had been placed in the central hall next to the drives of the safety control system and...the reactor had set it off. This led on to the idea of a prompt-neutron excursion. At that same time, that night, I reported the situation to Dolgikh. He asked me: Could there be another explosion? I said no. Even by that time we had measurements around the reactor —no more than 20 neutrons per centimeter. Later, it went to 17-18 neutrons. As though there were no reaction. To be sure, we made the measurements at a distance and through concrete. We do not know what the true density of neutrons was. We did not take measurements from the helicopter....

"That same night, I designated a skeleton crew to attend the first, second, and

third units. I drew up the lists, gave them to Bryukhanov. On 29 April, during the conference in Chernobyl, I proposed that all 14 other units with RBMK-type reactors be shut down. Shcherbina listened in silence, then, after the conference, when people were leaving, he said: 'You, Gennadiy, what are you doing, don't start an uproar. Do you realize what it means leaving the country without 14 million MW of installed capacity...?'"

On 29 April, the government commission left Pripyat and went off to Chernobyl.

6

And at that time, USSR Minenergo in Moscow had provided an emergency and large-scale shipment of special equipment and materials to Chernobyl through Vyshgorod. They snatched from everywhere and rerouted to the disaster area cement mixers, concrete layers, cranes, concrete pumps, concrete-mixing plants, trailers, trucks, bulldozers, dry concrete mix, and other building materials....

I learned about the accident on Monday morning, 28 April, from Yevgeniy Aleksandrovich Reshetnikov, chief of the Main Production Administration for Construction of USSR Minenergo, when I went to report to him on the results of my trip to the Crimean Nuclear Power Plant. On the morning of the 29th, Deputy Minister Sadovskiy, according to our information, reported on what had happened to Dolgikh and Ligachev. Later, we learned about the fire on the roof of the turbine hall and the partial collapse of the roof. And only on subsequent days did it finally become clear in the ministry in Moscow that a nuclear disaster had occurred at the Chernobyl Nuclear Power Plant such as had no equal in the nuclear power industry.

A continuous duty watch was organized, the traffic of shipments to Chernobyl was monitored, priority needs were met. It turned out that there were no machines with manipulators to collect radioactive pieces of debris. The explosion had scattered radioactive graphite and fragments of fuel over the entire grounds around the unit. We contracted with a West German firm to purchase three manipulators for 1 million gold rubles to pick up the fuel and graphite on the grounds of the nuclear power plant. A team of our engineers headed by N.N. Konstantinov, chief mechanical engineer of Soyuzatomenergostroy, went immediately to West Germany for training and for acceptance of the machines. Unfortunately, we never managed to put them to use. They worked only on level ground, but at Chernobyl there were heaps everywhere. Then they were lifted to the roof to pick up the fuel and graphite on the roof of the deaerator galleries, but there the robots became entangled in the hoses left behind by the firemen. As a consequence, the fuel and graphite had to be gathered up by hand....

4 May 1986

On Saturday, 4 May, Shcherbina, Mayorets, Maryin, Semenov, Tsvirko, Drach, and the others arrived from Chernobyl. They were met at the Vnukovo Airport

by a special bus, which took them all off to Clinic No 6. Tsvirko, who had high blood pressure and hemorrhaging in both eyes, contrived to run off to the Kremlin Hospital. "Where have you come from?" they asked him there. "From Chernobyl.... I got irradiated...." "We do not know how to treat anything like that...." Then he went off to Clinic No 6. There they "sniffed" everyone with the counter, undressed them, washed them, and shaved them. Everything was highly radioactive. Shcherbina alone did not let them shave him. After washing, he changed into clean clothes and went off home with radioactive hair. (Shcherbina, Mayorets, and Maryin were processed separately from the others in a medical unit next door to Clinic No 6.)

Everyone except Shcherbina, who had left the clinic, and Mayorets, who was quickly washed clean, was left for examination and treatment in Clinic No 6, where they spent from a week to a month. A new government commission headed by Silayev, deputy chairman of the USSR Council of Ministers, flew off to Chernobyl to replace Shcherbina.

Testimony of G.A. Shasharin:

"On 4 May, we found a valve which had to be opened in order to drain the water from the lower part of the bubbler basin. There was a little water there. We had looked into the upper basin through a hole in the spare passageway. There was no water there. I supplied two diver's suits and gave them to the military people. The military men went to open the valves. They also used mobile pumping stations and hoselines. Silayev, the new chairman of the government commission, offered a deal: in case of death of the person opening it—a car, a dacha, an apartment, support of the family for life. Those who took part were Ignatenko, Saakov, Bronnikov, Grishchenko, Captain Zborovskiy, Lieutenant Zlobin, the Junior Sergeants Oleynik and Navava...."

Testimony of B.Ya. Prushinskiy:

"On 4 May, I flew in a helicopter to the reactor along with Velikhov, member of the academy. After he had carefully examined the destroyed power unit from the air, Velikhov said concernedly: 'It is hard to figure out how to tame the reactor....'

"This was said after 5,000 tons of various materials had been dumped in the nuclear crater...."

5 May 1986

Chernobyl was evacuated. The 30-km zone was established. Population and livestock were evacuated. The staff headquarters of the government commission retreated to Ivankov. The discharge. The radioactivity of the air had risen sharply.

Marshal Ogankov and his aides were drilling in the explosion of shaped charges over in Unit 5. Officers and installation workers were helping. On 6 June, they were to set off charges under real conditions in the damaged unit. A hole was needed for the pipeline that would carry the liquid nitrogen under the foundation slab for cooling.

6 May 1986

Shcherbina's press conference. In his speech, the radiation background around the unit and in Pripyat had dropped. Why?

A.M. Petrosyants, chairman of the USSR State Committee for Use of Atomic Energy, uttered blasphemous words justifying the Chernobyl disaster: "Science demands sacrifices."

Marshal Ogankov was setting off shaped charges in the damaged unit. They attached a charge to the wall of the VSRO on the Unit 3 side, and they set it off with a Bickford fuse. They made a hole in the walls of three rooms. But pipelines and equipment turned out to be along the route and were in the way of the pipeline. The hole had to be made much wider. They couldn't decide....

V.T. Kizima proposed another solution: instead of demolition, to cut through with a welding arc from the transport corridor. That was where Room 009 was. They began preparations for the work. To reduce the burning of graphite and access of oxygen into the core, they connected nitrogen to the receivers and fed it in under the members supporting the reactor....

Radioactivity in Kiev (the air) was about 2,000 doses on 1 and 2 May. This was reported by an installation worker who arrived. The data need to be checked.

7 May 1986

A staff headquarters of USSR Minenergo was set up in Moscow to provide

prompt and long-term help to Chernobyl. Duty watch until 2200 hours in the office of First Deputy Minister Sadovskiy.

Conference in the office of Deputy Minister Semenov. Specialists of Glavgidrospetsstroy said it was impossible to break into the damaged unit with a directed charge. The soils of Pripyat are mainly sand, which is not amenable to a directed explosion. Heavy soils are required, and they do not exist there. The sand is simply swept aside in all directions by the explosion. What a pity! Nuclear power plants should be built on heavy soil just in case later they have to be blocked up with earth and turned into something like a Scythian burial mound.

The first radio-controlled bulldozers arrived at Chernobyl: Japanese Kamatsus and our own DT-250's. There was a big difference in operating them: ours is started by hand, and controlled by remote; if the engine stalls during operation where the radiation is high, a man has to be sent to start it up again. The Japanese Kamatsu is started and driven by remote.

A traffic dispatcher called from Vyshgorod, where equipment is being assembled for Chernobyl. He said that an immense number of machines have been assembled already. There are a great many drivers. Unmanageable. There are difficulties organizing housing and food. They are drinking everywhere. They are talking in favor of decontamination. The radioactivity in Kiev and Vyshgorod: 0.5 milliroentgen per hour in the air and 15-20 milliroentgens on the surface of roads and the asphalt. The order: break up the drivers into squads of 10 and make the most conscientious one the head of each squad. Send the incorrigibles back home. In future, take on people on the basis of the need to have an ongoing pool from which to replace those who are disabled, that is, who take a dose of 25 rems.

There were times at Chernobyl when the radioactivity of the air increased sharply. Plutonium, transuraniums, and others. In these cases, emergency relocation of staff headquarters and dormitories to a new and more distant place. Bed linen and furniture left behind. Everything furnished from scratch at the new place. When N.I. Ryzhkov, chairman of the Council of Ministers, arrived in the disaster zone, people specifically complained to him about the bad medical service. The prime minister gave Health Minister Petrovsky and his deputies a proper dressing down.

But unfortunately, we did not have in the country the necessary specialized equipment for combating and localizing nuclear disasters like the one at Chernobyl. Such as the "wall in the ground" machine with sufficient trench depth, robotic equipment with manipulators, and so on. Deputy Minister A.N. Semenov came back from the conference with Marshal Akhromeyev, deputy defense minister. He said: the conference was representative, some 30 colonel generals and lieutenant generals. V.K. Pikalov, chief of chemical forces, had been there. The marshal had given those attending a good dressing down.

Telephone call from V.T. Kizima, chief of the construction project in Chernobyl. He is complaining about the shortage of automobiles. Drivers and vehicles coming from various places go off on their own with their radioactive vehicles after they have gotten their dose. The vehicles do not get washed off. The radioactivity inside goes as high as 3-5 roentgens per hour. He is requesting accumulator dosimeters and optical dosimeters. The shortage is acute. The dosimeters are being stolen. Those who leave carry them away as souvenirs. The weakest point is organization of the dosimeter service for builders and installers. Operations are demoralized, cannot even support itself....

The "go ahead" has been obtained through civil defense for 2,000 optical dosimeter kits complete with power packs and rechargers from the Kiev depot. I passed the whereabouts on to Kizima. Asked him to send a truck.

The staff headquarters of USSR Minenergo is receiving telephone calls, and many Soviet citizens are coming in asking to be sent to Chernobyl. Most of them, of course, have no idea of the kind of work that awaits them. But for some reason irradiation does not disturb anyone. They say: after all, on the assumption of 25 roentgens.... Some say it straight out: they want to make money. They have learned that five times the regular salary is being paid in the zone adjoining the damaged unit.... But most are offering their help unselfishly. One soldier from Afghanistan who has been discharged said: "Well, so what if it is dangerous? Afghanistan was no stroll through the park. I want to help the country."

We have prepared the draft of the government decree on Chernobyl, entitled "On Measures To Repair the Damage of the Accident" (supplying equipment, vehicles, chemicals for decontamination, benefits for builders and installers). Minister Mayorets is reporting today in a meeting of the Politburo.

2000 hours. A decision has been made to apply wet concrete to the pile of debris

in order to embed the pieces of fuel and graphite and reduce the radiation background. Sixty welders are urgently needed to assemble the pipeline. Order of Deputy Minister A.N. Semenov to P.P. Triandafilidi, chief of Soyuzenergomontazh: Make the people available. Triandafilidi heatedly shouts at Semenov: "We will burn up the welders with radiation! Who is going to assemble pipelines at the power plants being built?!" A new order followed from Semenov to Triandafilidi: Prepare a list of welders and installers and send it to the defense ministry for their mobilization.

In view of the anticipated rains in the area of the Chernobyl Nuclear Power Plant—an order of the chairman of the government commission Silayev, deputy chairman of the USSR Council of Ministers: "Urgently undertake to realign the storm drains of the city of Pripyat so that they empty into the reservoir of the cooling pond. (Previously, they went into the Pripyat River.—G.M.) The entire staff headquarters of the government commission is to go to the damaged unit to organize urgent steps to cover the radioactive pieces of graphite and fuel ejected by the explosion...."

When he was signing my travel orders for Chernobyl, Deputy Minister Aleksandr Nikolayevich Semenov said: "Get something definite on the radiation fields. When we were there, it was obvious that no one knew how much radiation there was, and now they are concealing it, practicing deception. And in general you will come back and tell me. While here I sit with my hair shaved.... And my blood pressure shooting up.... Could that be the radiation...?"

At Bykovo, we waited a long time for the minister. He arrived an hour late accompanied by his aide, whom he had brought with him to Minenergo from Minelektrotekhprom, where he had previously been minister.

In addition to me, there were three other deputy chiefs of main administrations of USSR Minenergo on the flight: I.S. Popel—deputy chief of Glavsnab, Yu.A. Khiyesalu—deputy chief of Glavenergokomplekt, and V.S. Mikhaylov, deputy chief of Soyuzatomenergostroy, a spry fellow with sociable manners, but with very tenacious and attentive eyes. He was just like mercury, a typical choleric type, he could not sit still a minute, he would unfailingly come up with some sort of pros and cons and initiatives. Yolo Aynovich Khiyesalu is a calm and quiet man, he does not speak unnecessarily, and when he speaks, he speaks with a strong Estonian accent. An extremely likable and decent man. Igor Sergeyevich Popel is a vigorous, broad-faced supply expert with a cheerful nature. All three

were going into a zone with high radiation for the first time in their lives.

The special trip was being taken on a YaK-40 aircraft chartered by USSR Minenergo that had been specifically adapted to carry the top brass. The cabin was divided into two small sections: a forward one for the higher brass and the tail section where all the rest were accommodated. To be sure, subordination had been observed in the pre-Chernobyl era, but the disaster had abruptly democratized the situation on the special trips.

The minister and his aide had disposed themselves opposite one another in armchairs at a small table on the left side in the forward cabin. On the right side, were four chairs one behind the other which were taken by the deputy chiefs of the main administrations, the chiefs of the production departments, and the staff services of various administrations of the ministry.

Of all those taking this trip, I was the only one who had worked for a long time in operating nuclear power plants. Even the minister himself, although he had spent the first nuclear week in Pripyat and Chernobyl, had been irradiated and was now sitting there with all his hair shaved off, did not fully grasp what had happened and was not capable of independently solving the interrelated problems that arose without the help of specialists. Plump and well-groomed, he sat there in silence, and not once spoke to any of his subordinates in the cabin. A barely detectable smile glimmered on his face. I examined him unobtrusively, and it seemed to me that he had been affected by what happened, by this nuclear disaster that had suddenly come crashing down on him. It was as though written on his face: "Why did I get into this branch of power engineering alien to me, why did I heap on my shoulders the construction and operation of nuclear power plants? Why did I leave my cherished electric motors and transformers? Why...?" He was clearly dumbstruck by this nuclear mess that had fallen into his lap. Dumbstruck, but not frightened. He could not be frightened, for he did not understand that a nuclear disaster was dangerous. Moreover, he did not agree that a disaster had occurred. Simply an accident.... Some minor damage....

Kafanov, deputy chief of Soyuzgidrospetsstroy, was also on the flight with us: a tall men who looked gloomy and had a puffy face. He gave the appearance of Olympic calm, but it was also the first time that he would be coming up against radiation.

Below, we could already see the overflowing Dnieper. It was good that the rains

had ended, had the disaster occurred a month before, all the radioactivity would have ended up in the Pripyat and Dnieper....

Mikhaylov was making rustling sounds behind me. He was disturbed by the uncertain future, he wanted to clear up everything in advance and asked me in a whisper, evidently not wanting the minister to hear: "Tell me, how much can one take to be, well...without consequences...? You know, with no aftereffects...?" Popel was also agitated. I heard his distinct fine voice beside me: "I have high blood pressure. I have heard that the rays make it jump way up...." Kafanov and Yolo Aynovich Khiyesalu were silent. During the entire time of the flight, the minister's face did not change expression. The gray absent eyes, with that shade of perplexity, were looking at something in front of him which we could not see.

We were approaching Kiev sometime after 1700 hours. We would land at the Zhulyana Airport. We flew low over Kiev. The streets were unusually deserted for the rush hour. Extremely few pedestrians. I had often approached Kiev from this side, but it had never been so devoid of people.

At length, we landed. The minister immediately drove away in a ZIM. He had been met by Sklyarov, Ukrainian power minister, who was pale as death, and the obkom secretary. We were met by Maslak, chief of the supply administration of UkSSR Minenergo, a thin, affable, and cheerful person with a bald head. Our entire team fitted into the blue "rafik."

Maslak said that the radioactivity in the air of Kiev, according to the radio, was 0.4 milliroentgen per hour, which is considerably higher on the asphalt, but they did not report that. He had heard 100 times more, but he did not know what it meant, since he had never had dealings with the atom before in his life. He said that about a million people had left Kiev during the week. During the first days, the scene was incredible at the station, more people than for the evacuation during the war. Speculators hiked up the price of tickets to 200 rubles in spite of the additional trains allocated to those leaving. There was hand-to-hand combat in boarding the cars, and when they left there were people on the roof and the platforms. But the panic lasted no more than 3 or 4 days. Now you could freely leave Kiev.

"But what is this—all of 0.34 of milliroentgen per hour?! I don't like it!" The impatient V.S. Mikhaylov turned to me with his little graying Kurchatov beard.

He said that an ordinary mortal could take 1.3 milliroentgens per day. That is the dose stipulated by the standard of the WHO (World Health Organization). At that point, that is, on 8 May, in Kiev, if one was to believe the official figures, the radiation exceeded the WHO standard sixfold. And on the asphalt, to believe Maslak, it was 300 times greater.

The "rafik" drove through half-empty streets. The time was 1900 hours.

"They say," Maslak said, "that the radioactivity in Kiev went as high as 100 milliroentgens per hour in the first days after the explosion."

"Two thousand doses compared to the standard for ordinary mortals," I explained.

"Well, you know!" the expansive Mikhaylov exclaimed. "Maslak! Where are your dosimeters? You are the supply administration, give us dosimeters!"

"You will get dosimeters in Ivankov."

"Stop, stop!" Mikhaylov started repeating to the driver. "Right here by the store. We have to get something to drink for decontamination."

The driver smiled, but he had no intention of stopping. In the last 10 days, he had seen that he had not died, that one could go on living.

We drove outside the Kiev city limits. I looked at a pine tree by the side of the road that was as tall as a ship mast, knowing that the radioactive filth was also here now, although externally everything seemed so clean and orderly. And noticeably fewer people, and the people seemed somehow solitary. And very few vehicles coming to meet us from the direction of Chernobyl.... We passed by Petrivtsy, Dymer. Dachas, settlements by the roadside. Rare pedestrians. Children with satchels were going home from school after the second shift, and they were all like any others, but somehow different.... As though everything had slowed down. Thinned out and slowed down.

What I have been describing in these last sections (the events of 26 and 27 April) I put together later, after visiting Chernobyl and Pripyat, after a meticulous questioning of many people, Bryukhanov, shop and shift chiefs in the nuclear power plant, participants in the tragic events. I was aided in understanding and reconstructing the entire course of events by the many years of experience I had

had working in the operation of nuclear power plants and by having been irradiated and spending time in the hospital of Clinic No 6 in Moscow in the seventies. At that time, no one knew the whole picture, each of the eyewitnesses or participants in the events knew only his small little piece of the tragedy....

The "rafik" sped along the broad and utterly empty limited-access highway between Kiev and Chernobyl, which even 10 days before had been very lively and brilliant with the headlights of cars. I would have to make my way through to the Chernobyl staff headquarters today, I thought, arrive for the evening session of the staff headquarters of the government commission. But the "rafik" did not enter the yard of the Ivankov power system until 2100 hours. We got out and stretched our legs. We had a quick snack in the wooden barracks, right there in the yard. There was a small dining room for the power system's operating personnel. Three workers who had recently come from Chernobyl were carrying on an excited conversation not far away in the yard. One was in white, two in blue cotton coveralls, with dosimeters in their breast pockets. The one in white, tall and bald, was pointing with the cap he had torn from his head to the northwest, high in what was now the evening sky, which was overcast with a dirty haze:

"It is burning today—2,000 doses of plutonium, it is stifling." He frowned, coughed, wiped his wrinkled face with his cap.

We also began to look in that direction. The sky was sinister and silent. We all looked and looked in that direction with the feeling one might have if the war, the front, was over there.

"And I have the itch," another one said, "my whole body itches, allergy.... Especially my ankles."

Pulling up the trousers legs of the coveralls and bending over, he began a frenzied scratching of his legs, which were purple and swollen.

Maslak came back.

"No safety clothing, no dosimeters, nowhere to spend the night. We will go to Kiev. We cannot go to Chernobyl like this, they will turn us back. Those first days, they say, no telling how people were dressed...."

Nothing else could be done, we sat in the "rafik" and went back to Kiev. At the

Kiyevenergo Hotel, an enormous bag containing blue cotton safety clothing, safety shoes, and black woolen berets. It was not good for the berets to be made of wool. Wool is an excellent absorber of radioactivity. They should be cotton, but there were no cotton ones. You take what you can get.

In the morning, a blue summer sky, the temperature was 25° C. We drove out again in the "rafik." As we were leaving Vyshgorod, at the State Vehicle Inspection Station there was a dosimetrist. He was stopping the rare vehicles from Chernobyl and "sniffing" the wheels with counters. By the side of the road was a blue Zhiguli with the doors and trunk wide open. Inside, bundles of things, carpets. The owners, a man and a woman, were standing alongside. "But what is this?!" the woman lamented. "But don't take our property...."

"The air is bad today." The driver pulled over his nose the antidust breathing mask that was hanging around his neck. It burned when you breathed, and the burning of the eyelids was getting stronger and stronger. Following the driver's example, they all put on their breathing masks, but I was ashamed for some reason. Ashamed to give in to the radiation, damn it to hell! There was drifted dust ahead on the asphalt. The Volga in which the minister was riding passed us, a cloud of dust with radioactivity of about 30 roentgens per hour enveloped the "rafik." I put on my breathing mask. The minister's Volga disappeared around the bend. Again, we were the only ones on the road. Now and then we would pass a ponderous cement truck crawling along with a load of dry concrete mix. And then again, quiet and empty. Not a soul in the broad expanses of fields or in the villages and on the farms. The greenery was still fresh. But soon, I knew this from experience, it would begin to darken and turn black and shrivel, and the needles of the firs and pines would turn rust-colored. The shoots of winter crops, which had built up their strength, would begin to droop, and, like sheep's wool, what might be called the earth's hair, would collect radiation. Two or three times as much would accumulate there as on the surface of the roads.

Popel complained of headache.

"The blood pressure has climbed up," he concluded. "I went through the war, survived so much.... When we get there, I will'immediately ask Sadovskiy whether I am needed here? After all, I could do more in Moscow than in Chernobyl, 1,000 times more.... And 100 times faster."

Mikhaylov, Razumnyy, and Kafanov were constantly looking into the eyepieces

of their dosimeters.

"But my arrow has gone all the way over to minus, to the left of zero," Razumnyy said. "Some quality, slipshod work everywhere!"

"That's because you are not absorbing any yet, you are giving off roentgens," Filonov joked. "You're giving off more than you're taking in."

"And mine stands exactly at zero," Mikhaylov announced. "But my eyes burn, and the itch is beginning in my legs." He scratched his ankles frantically.

"That's a case of fright you've got, Valentin Sergeyevich," Razumnyy said.

Not a soul around. No birds visible, but no, there far away was a raven flying lazily and not very high. It would be interesting to measure its radioactivity. How much radium would it have accumulated in its feathers? And then after a few kilometers another living creature. A piebald foal came running down toward us on the shoulder of the road from the direction of Chernobyl, whipping up the radioactive dust. It was confused, lonely, turning its head this way and that way, looking for its mother, neighing mournfully. They had already been shooting all the livestock in these parts. It had remained miraculously intact. Run, get out of here, little one. Though its hide would also be very radioactive, but still run, get out of here. Perhaps it will be lucky....

We were quite close to Chernobyl. To the right and left were military camps, tent cities, soldiers, a lot of equipment: armored personnel carriers, bulldozers, engineering machines for removing obstacles (IMR's for short) with mechanical hands (manipulators) and bulldozer blades mounted on them. They were like tanks except they did not have the gun turrets. And then more tent cities. Soldiers, soldiers, and more soldiers.

We were approaching the raykom. Here again, there were a great many machines. Mainly automobiles of various models, buses, "Cubans," "rafiks," armored personnel carriers, allotted to the members of the government commission. All these automobiles and other machines would have to be buried after a time: in a month or 2 they would accumulate so much radioactivity that inside it would be between 5 and more roentgens per hour.

I went along the corridor on the first floor. Sheets and scraps of paper were stuck up on the doors with drawing pins, reading: "IAE" (Atomic Energy Institute),

"Gidroproyekt," "Minugleprom," "Mintransstroy," "NIKIET" (the reactor's main designer), "Academy of Sciences," and many others. I looked into the room saying "IAE." Two desks close to one another by the window, at the left one Yevgeniy Pavlovich Velikhov, at the one on the right Minister Mayorets in the same blue cotton coveralls I was wearing and the woolen beret on his head that had been shorn with clippers. Alongside them in chairs were Sidorenko, deputy chairman of Gosatomenergonadzor and corresponding member of the Academy of Sciences, Legasov, member of the academy, Deputy Minister Shasharin, and Ignatenko, deputy chief of Soyuzatomenergo.

Mayorets was pressing Velikhov, member of the academy:

"Yevgeniy Pavlovich! Someone has to take organizational leadership into his hands. There are dozens of ministries here, Minenergo is unable to bring them all together...."

"But the Chernobyl Nuclear Power Plant is your plant," Velikhov parried, "you in fact must bring them together." Velikhov was pale, in a checked shirt, which was unbuttoned and showed his hairy stomach. A fatigued appearance, he had already taken about 50 roentgens. "Anyway, Anatoliy Ivanovich, we have to realize what has happened. The Chernobyl explosion is worse than Hiroshima. That was one bomb, but tenfold more radioactive substances have been discharged here. And half a ton of plutonium as well. Today, Anatoliy Ivanovich, we have to count people, count lives...."

I later learned that in those days the phrase "count lives" took on a new meaning: In the evening and morning sessions of the government commission, when a particular task of one kind or another came up, collecting fuel and reactor graphite around the unit, going into the high radiation zone and opening or closing some valve—the chairman of the government commission would say: "We have to stake two or three lives on this.... And on this, one life." This was uttered simply, as an everyday matter.

The people directing recovery from the Chernobyl accident would, of course, make mistakes, but you cannot deny them personal courage.

I left the office. I was in a hurry to find Bryukhanov as fast as possible.... What I had cautioned about 15 years ago in Pripyat had happened. It already seemed that I was almost right: the Chernobyl Nuclear Power Plant was the best in the

system of USSR Minenergo, it generated kilowatts over and above the plan, small accidents were hidden, it was on the Honor Roll, it won challenge banners. Medals, medals, glory...the explosion.... I was choking with anger.

In the short corridor which was half in the dark, there was a small and frail man in white cotton coveralls without a cap leaning against the wall: gray curly hair, powder-pale wrinkled face, expression of confusion and depression. His eyes were red, poisoned.... I walked past him, and suddenly it struck me: "Bryukhanov!" I turned:

"Viktor Petrovich?!"

"One and the same," said the man against the wall in the familiar flat voice.

The first feeling that arose in me when I recognized him was a feeling of pity and sympathy. I do not know where my anger and fury disappeared to. The man standing in front of me was pitiful and crushed. For a long time, we looked silently into each other's eyes.

"So that's how it is," he finally said and looked away.

Strange to say, at that moment I was ashamed to have been right. Better that I had not been right.

"You are looking bad," I said, somehow absurdly. That's right, absurdly. For it was actually through the efforts of this man that hundreds and thousands of people had become irradiated. Nevertheless, I could not speak to him otherwise. "How many roentgens have you taken?"

"A hundred, a hundred and fifty," the man standing by the wall in the semidarkness replied in that flat, hoarse voice that was so familiar.

"Where is your family?"

"I do not know. In Polyesk, it seems.... I do not know.... I am hanging around like a dermo around an icehole. There is no one here who needs me...."

"And where is Fomin?"

"He has gone off his head.... They let him go off to rest.... To Poltava...."

"What is your assessment of the situation here now?" "All Indians and no chiefs."

"I was told that you asked Shcherbina for permission to evacuate Pripyat on the morning of 26 April. Is that right?"

"Yes.... But they told me: do not start a panic.... That was the most terrible and horrible night for me...."

"For everyone," I said. "Why are we standing here? Let's go into some empty room."

Again our eyes met. There was nothing to say. Everything was clear as it was. For some reason, I recalled seeing him on television, at the congress the camera had sought out his face in the hall several times. The face of

a man who had achieved the height of recognition. And again...and again.... It was an authoritative face....

"You reported to Kiev on 26 April that the radiation situation was within the limits of the standard?"

"Yes.... That is what the instruments indicated.... What is more, that was a state of shock."

I took my notebook to make an entry, but he stopped me.

"Everything here is very dirty. Millions of particles on the desk. Don't dirty your hands and the notebook...."

Mayorets looked in, and Bryukhanov, evidently out of habit, jumped up readily, forgetting about me, and went up to him.

A man I didn't know introduced himself to me, again a man with a powderpale face (under the effect of radiation doses up to 100 roentgens, there are spasms of the outer capillaries of the skin, and the impression is given that the face has been powdered). He proved to be a section chief in the power plant. He said with a bitter smile:

"If it had not been for the experiment with the spinning of the generator,

everything would have been as before...."

"How much have you taken?"

"About 100 roentgens. A hundred and fifty roentgens were radiated from the thyroid gland in the first days. It has already dropped off now.... Iodine-131. There was no point not letting people take the things they needed. Many are suffering very much now. They could have been put in polyethylene bags...." And he suddenly said: "I remember you, you worked with us as deputy chief engineer in Unit 1."

"And there is something that I have forgotten.... Where are your people now, the operating personnel?"

"On the second floor, in the conference room and in the neighboring room."

I went up to the second floor. Outside there is a great deal of radiation in the air, I thought, why don't they shield the windows with lead? Along the corridor, mainly doors to the offices of ministers and members of the academy. But here was a door with no sign. I opened it and looked in. An oblong room, the windows halfshuttered. A gray-haired man was sitting at a desk. I recognized Silayev, deputy chairman of the USSR Council of Ministers. In the past, he had been minister of the aviation industry. He had replaced Shcherbina here on 4 May. The deputy chairman looked at me in silence. The eyes glittered authoritatively. He remained silent, he was waiting for me to speak.

"The windows need to be screened with lead sheet," I said, without saying who I was.

He remained silent, but little by little his face took on a fierce expression. I closed the door and went off to the conference room....

I should mention that it was considerably later, on 2 June, under Voronin, deputy chairman of the USSR Council of Ministers, who replaced Silayev, when the reactor spit out its next lot of nuclear filth from beneath the bags of sand and boron carbide that had been dumped on it.

The operations people were sitting on the stage of the conference room at the presidium's table and they had several telephones with which they were maintaining ongoing communication with the nuclear power plant's underground

shelter and the control rooms of the first three units. All those sitting in the seats of the presidium had guilty faces, there was not the former military bearing and confidence of nuclear plant operators typical of the times of success and glory.

People were sitting in small groups on chairs in the hall. By the window, 1 saw an old friend, chief of the chemical shop Yu.F. Semenov; he was discussing something with a man in safety clothing whom I did not know. I had hired Semenov back in 1972; at that time, he had a great longing to come to the Chernobyl Nuclear Power Plant. He was an intelligent specialist, he had worked for many years on the specialized treatment of radioactive water.

"Hello, old man!" I interrupted his conversation.

"Ohhh! I am glad to see you. But you see in what times you have come...."

"So, here I am...."

Semenov, also powder-pale, had aged greatly in the last several years. The tar-black sideburns had become quite white. About 2 years before, he had applied for a pension on the first list, he intended to leave the shop.

"You already intended to leave for clean work?"

"Well, yes.... I did intend to, but I lingered on. But where to go now.... Now I am needed here."

"Where are your wife and daughter?"

"They were unable to take things with them. Everything that had been acquired, it is all gone to ruin. And the dacha and the car. I had just bought a new one.... In my apartment, I drove over there yesterday, 1 roentgen per hour on everything. How to go away with this? The first residential district, it took most of all from the radioactive cloud."

By the window was an enormous bag of soccer ball bladders which were whitish with talc. Why so many of them?

"We are taking air samples," one of the operators explained.

"Where?"

"Well, everywhere. In Pripyat, in Chernobyl, and in the 30-km zone...."

"Why these, instead of Turkin bladders?" (The Turkin bladder is a plastic harmonica with a valve through which the portion of air or gas for the test is drawn in when it is stretched.)

The operator laughed:

"Where are you going to get Turkin bladders? And we have a pile of these...."

"How do you inflate them? With a pump?"

"In some places with a pump, in some places by mouth. You can't find bicycle pumps either. The shortage is terrible under present conditions."

"If it is inflated by mouth, the reading will be inaccurate," I said. "When I inhale, half of the radioactive substances remain in the lungs. The lungs operate like a filter. There is an accumulation of radioactive filth in the lungs with every breath that is inhaled and exhaled."

"But what is to be done?" the operator laughed. "We have not been paying attention to such trifles."

In the former office of the first secretary, familiar and unfamiliar people in cotton coveralls, Bryukhanov was sitting without taking part at the end of the table. On the table were photographs of the damaged reactor taken from a helicopter and a general plan of the industrial area.

Bryukhanov poked his finger at one of the photographs:

"This is the holding tank for the spent fuel. Packed full of fuel assemblies. At this point, there is absolutely no water in the tank, it evaporated. The assembly will rupture from the residual heat given off...."

"You are not thinking of taking them out of there?" Ignatenko said. "We will bury them along with the reactor...."

A tall, elderly general came in in his dress uniform.

"Who will give me some information, comrades? I command a group of Army

dosimetrists. I have been absolutely unable to make contact either with the builders or with the operating personnel, we have to have some coordination."

They advised him to find Kaplun, he was the chief of the dosimetry service at the power plant.

I had my own worry: I needed a car to drive to Pripyat and to the unit. Ignatenko refused: he said ask Kizima. I went down to the dispatcher station on the first floor. V.I. Pavlov, deputy chief of Glavtekhstroy of USSR Minenergo, was on duty at the telephone.

"Do you have a car?" I asked. "To get over to Kizima's staff headquarters."

"No, unfortunately. Everyone here has his own wheelbarrow. A thousand bosses, there is no making head nor tail of it. Sadovskiy went off somewhere in his Zhiguli...."

"OK, I will go on foot. Good-bye."

Vapor is rising from the asphalt, which has been washed with desorbing solutions. A nauseatingly sweet odor. I walk along the street, which is going upward. It is quiet. Even the leaves are somehow muted, as though they have been slowed down. Still not dead, but unnatural, like leaves covered with wax, preserved, and they have stopped moving and are being listened to, sniffed at for ionizing gas. The air after all is radiating about 20 milliroentgens per hour.... But the trees are still alive, they still find in that plasma something of their own which they need for life. Both the cherries and the apples are in full bloom. In some places, the fruit has even set. But all of it, both the blooms and the tiny fruit, are now accumulating radioactivity.

A girl of about 20 in white cotton coveralls is breaking off branches of the flowering cherry near the wattle fence of an abandoned yard. She plunged her face into the bouquet.

"Young lady, the flowers are 'dirty.'"

"Oh, go on," she waved her hand and again started to break the branches.

I also broke several branches covered with white blossoms. I set off with the bouquet for Kizima.

Kizima's staff headquarters was in the former building of the vocational and technical school. Full of people. They were standing and sitting in little groups, walking here and there on business or idly. The vehicles coming and going raised clouds of dust which did not have long to settle. Most people's breathing masks were hanging around their necks. Some pulled them over their nose when the dust was raised. About 30 meters from the vocational and technical school, in the backyard, were radioactive concrete trucks, concrete mixers, and dump trucks which had broken down. There was a dense linden tree near the porch of the vocational and technical school. No birds could be heard. A large blue fly was buzzing persistently in the rays of the rather hot sun. All the life had not disappeared. There were flies. And not only large blue flies, but also ordinary houseflies. Many flies inside the building. From the odor striking my noise, it was clear that the toilets here were not working well. At the entrance, a dosimetrist measured the activity of the special clothing worn by a worker of short stature in coveralls that were the safety color. The worker's face was reddish brown (the nuclear sunburn), he was excited.

"Where have you been?" the dosimetrist asked, applying the counter to the thyroid gland.

"In the ruins.... Also in the transport corridor...."

"Don't go there again.... You have had enough."

"How much have I had?"

"I said don't go there anymore," the dosimetrist said and walked away. I asked him to measure the radioactivity of the bouquet of flowers.

"Twenty roentgens per hour. Get rid of them...."

I threw the bouquet in the backyard toward the radioactive machines.

Several people came out of Kizima's office. Excited. Kizima was alone, he was uncorking a bottle of mango juice. On his cheeks were gossamer from the fibers of Petryanov cloth used in the breathing masks.

"Greetings, Vasiliy Trofimovich!"

"Ah, greetings to the Muscovites!" he responded joylessly. He nodded toward

the bottle: "The whole range of vitamins. It helps against radiation." He drank greedily, his Adam's apple twitching convulsively.

The telephone rang. Kizima took the receiver.

"Yes! Kizima.... I am listening, Anatoliy Ivanovich.... The minister," he whispered to me, covering the mouthpiece with his hand. "Yes, yes, I hear you. Take a pencil and paper? Yes, I have. I am drawing a line at 45°, so.... Now, a vertical line.... Yes.... Now, a horizontal line.... I have done it. You get a right triangle. Is that all?" He listened for a time and then put down the receiver. "So, you understand, I am working here as the job superintendent. Minister Mayorets works as the senior job superintendent, and Comrade Silayev, deputy chairman of the USSR Council of Ministers, works as the chief of the construction project. An utter mess. So, if you please, a call from the minister. He gave me a drawing over the telephone. A triangle...." Kizima showed me the sheet of paper. "This is the pile of debris alongside the unit. He said to pump the concrete onto it. As though I am a first-grader and know nothing. And I walked over that pile of debris on foot the morning of 26 April. And several times since then. And now just arrived from there.... And so, he tells me, you understand, to draw a triangle. So, I drew it, and what then? To be truthful, I have no use for them—neither the ministers nor the deputy chairmen. This is a construction project, there is the radiation hazard, but it is a construction project. I am the chief of the construction project. All I need is Velikhov as scientific adviser, the military people can organize the commandant's office and keep order. And people, of course. The people have scattered. I am thinking of the regular staff of the construction project. And also the supervisory personnel. More than 3,000 of them went off without documents and severance pay. One dosimeter for 25 people, and that one doesn't work. But even one that doesn't work has a magic effect. People believe in that hunk of iron. And without it they will not go where there is radiation. Here, you have a dosimeter.... Give it to me. I will use it to send out another 25 men."

"I will give it to you when I come back from Pripyat," I promised Kizima.

The job superintendent came in.

"Vasiliy Trofimovich, I need drivers for replacements. We are burning up people. This shift has already taken the quota. Almost all of them have 25 rems or more. The people don't feel good."

"But what about Yakovenko?" I asked. "Three days ago his dispatcher telephoned Moscow to complain that the trust could not handle the drivers sent there, that they were idle, that they drank vodka, that there was nowhere to put them up, nothing to feed them...."

"But what lies he tells! I am hurting for people!"

"My chest burns, I have a cough, my head aches," Kizima complained.

"Why don't you use lead to shield the windows and truck cabs? That would reduce the radiation."

"Lead is no good," Kizima said convincingly. "It frightens people and holds up the work."

We talked to Moscow. They were to urgently send drivers to replace those who had been irradiated. Yakovenko said that 25 men would arrive at Chernobyl the next morning as a replacement. The job superintendent went away encouraged. And immediately there was a knock at the door. A young major general and three other officers with him—a colonel and two lieutenant colonels.

"The podrazdeleniye has arrived to guard the cooling pond. So that there is no sabotage: they might blow up the dam, and all the dirty water would go into the Pripyat and Dnieper.... I am setting up sentry posts along the entire perimeter of the dam, but we need shelters to protect the sentries from irradiation."

"I suggest splash blocks," Kizima said. "We have these reinforced-concrete splash blocks. Set them upright at an angle and you have a sentry box. Shall I issue the order?"

A telephone call. Kizima took up the receiver.

"Yes.... Yes.... And what does Velikhov say? He is thinking...? Let him think. For the present, stop feeding the concrete onto the pile." He put down the receiver. "Geysers are starting to shoot up from the wet concrete. When the liquid falls on the fuel in the pile, there is either an atomic excursion or simply a disruption of heat exchange and a rise of temperature. The radiation situation deteriorates sharply."

"Vasiliy Trofimovich," I said, "I need to run over to the damaged unit. Can you

give me a car for an hour or 2?"

"We are in a bad way for cars.... OK. One of the chiefs here has gone off to Kiev for the day. Take his Niva. It has four-wheel drive, could come in handy. Pick up a radiometer from the dosimetrists. They will lend it to you for an hour or 2." Kizima told me the license plate number. "The driver's name is Volodya."

"He's not timid, is he?"

"He's a fighting lad. Not long out of the Army."

Volodya fortunately had a special pass to Pripyat. In 10 minutes, we had already jumped over to the limitedaccess highway and were going in the direction of the Chernobyl Nuclear Power Plant. I had driven this road hundreds of times in the seventies and later, when I was already working in Moscow. An 1,800-km ribbon of asphalt running from Chernobyl to Pripyat framed with meter-wide stripes of pink concrete. These were protective strips so as to keep the asphalt from crumbling off the sides. We were happy at the time to be the only ones to have such a road and that it would cost less to repair the roadway. But now....

"What if the engine stalls near Unit 4?" Volodya asked mischievously. "It happened to us once, though not near the unit, but in Pripyat.... Less radiation there...."

"If it shuts off, you will start it," I said. "In what specialty did you serve?"

"I drove the regimental commander in a VAZ-469. Here is a dosimetry station. Soldiers from the chemical forces, you see."

On the side of the road stood a large green tank truck with attachments mounted on it: pumps, instruments, hoses. A Moskvich came up from the direction of Pripyat, they stopped it and used a counter to measure the radioactivity of the wheels, the underside, and the roof. They asked the passengers and driver to get out. They began to wash the car with desorbing solutions. The soldiers were wearing breathing masks and cloth hoods that fitted tightly over the head and ears and extended down over the shoulders. One of the soldiers with a radiometer on his chest and a long stick-counter waved to us. We stopped. He checked the special pass, which Volodya had pasted to the windshield. Everything in order. He used the counter to sniff our Niva— background.

"You can go, but mind—you are going to get the car dirty there. The background on the Moskvich is 3 roentgens per hour. And it does not wash off. You don't care about the car?"

"We have a radiometer," I showed the instrument, "we will be cautious."

The soldier looked at me with his perceptive blue eyes: you won't fool me, old guy, he was thinking, and, slamming the door with force, he waved us through.

Volodya gave it the gas. The Niva flew along with a whine. I lowered the window and stuck out the counter. It would be interesting to know how the radioactivity increases as we approach Pripyat.

To the right and ahead, behind the radioactive foliage that was receding into the distance, there was a good view of the complex of the Chernobyl Nuclear Power Plant, which was snow-white in the rays of the May sunshine, and of the fine lacework of the towers of the 330and 750-kv ORU [unified switching facility]. I already knew that the explosion had thrown chunks of fuel onto the site of the ORU-750 and that there was plenty of siphoning from there....

Against the background of all that splendid whiteness and laciness, the terrible black wreck of the fourth power-generating unit made my heart ache.

At first, the dial of the radiometer showed 100 milliroentgens per hour; and then it confidently climbed rightward—200, 300, 500.... And suddenly it jumped off scale. I switched ranges. Twenty roentgens per hour. What from? Most likely the roentgen breeze from the damaged unit. After a few kilometers, the arrow of the radiometer fell back again, this time to 700 milliroentgens per hour.

In the distance was the clearly distinguishable and longfamiliar road sign saying "Chernobyl Nuclear Power Plant imeni Lenin," with the concrete torch. Beyond that, the concrete marker: "Pripyat, 1970."

"Let's go first to Pripyat, Volodya."

Volodya turned left, sped up, and we soon were on the overpass. The city was open before our eyes, white as snow in the rays of the sun. On the overpass, the pointer of the radiometer again shot off to the right. I started to switch ranges.

"Scram through this place. The cloud of the explosion passed here. Fallout

here.... Faster...."

We sped over the hump of the overpass at high speed and flew headlong into the dead city that was spread out in front of us. The first thing that struck the eyes, and it was a painful blow: the corpses of cats and dogs everywhere—on the roads, in the yards, in the squares, white, red, black, and spotted corpses of the animals that had been shot. Ominous traces of the abandonment and irreversibility of the misfortune....

"Drive along Lenin Street," I asked Volodya.

I still remember the number of the house where I lived when I worked here, No 9. The city looked strange. As in the very early morning. Everyone sleeping a deep unbroken sleep. Pots and pans and laundry on the balconies. Glints of the sun in the windows, resembling walleyes, and then a window that happened to be left open, and, like a dead language, a curtain flapping outside, fading flowers on the window sills....

"Stop, Volodya, go right here. Slow down...." The pointer of the radiometer crept back and forth between 1 roentgen and 700 milliroentgens per hour. "Drive slowly," I asked. "This is my house.... I lived here on the second floor. My, how the rowan has grown. All in radioactive bloom. When I was here, it did not reach the second floor, and now it is almost up to the fourth."

Empty. The blinds tightly drawn on the windows. One could sense that there was no life behind those blinds; they were somehow depressing, motionless. Outside on the balcony there were bicycles, various boxes, an old refrigerator, skis with red ski poles. Everything empty, silent, and dead.

The corpse of an immense black mastiff with white spots lay crossways on the narrow concrete drive of the inner court.

"Stop, I want to measure how much the coat has accumulated."

Volodya went off onto a flowerbed with the left wheels and stopped. The new shoots of flowers had been darkened by the radiation, and the flowers were withered. The radioactivity of the soil and the concrete of the drive was 60 roentgens per hour.

"Look, look!" Volodya shouted, pointing with his hand.

Two large emaciated pigs were running in our direction on the narrow little lane from the school along the wall of a long five-story building. They came running up to the car, squealing, crazily touching the wheels and the radiator with their snouts. They were looking at us with poisoned red eyes, they raised their snouts toward us, just as though begging something. Their movements were somehow out of synch, uncoordinated. They were swaying. I poked the counter toward the flank of the hog—50 roentgens per hour. The hog tried to seize the counter in his teeth, but I managed to pull it away. Then the hungry radioactive pigs started to devour the mastiff. It was rather easy for them to tear large hunks from the flank of the corpse, which was already decomposing, pulling the corpse apart and dragging it here and there over the concrete. A swarm of agitated blue flies rose up from where the eyes had been and the parted jaws.

"Let's go back, Volodya. Across the overpass to the damaged unit."

"And if the engine stops?"

"If it stops, you will start it. Let's go."

After he had taxied onto Lenin Street, he asked:

"Shall we drive on the wrong side of the street? Or how? Our side is over there. Go around the square?"

"No point."

"It somehow doesn't feel right. As though I am breaking the traffic laws." Volodya smiled sadly, and we tore along up the wrong side of the street past the corpses of dogs and cats toward the damaged power-generating unit.

We leaped over the overpass at top speed. Again, the pointer of the radiometer shot up several ranges and again dropped off. Off to the right, we could see the horrible picture of the damaged unit. The entire ruins and pile of debris were the color of black charred remains. Thready streams of ascending gas ionized by the radiation streamed upward over the floor of the former central hall where the reactor was. The drum separators, dislodged from their footings and displaced to the side, glittered with incongruous newness and ominousness in those ruins and the blackness.

It was about 400 meters to the unit.

"Engage the front axle," I told Volodya. "The increased traction could come in handy."

What was this? Inside the fence, soldiers were walking alongside the damaged block and right up to the pile of debris, gathering something.

"Turn right. Right here...go on.... Go behind the KhZhTO building and stop next to the enclosure.

"It is going to fry us," Volodya said, looking at me fixedly. His face was red and tense. We were both wearing the breathing masks.

"Stop here. Oh, ho! Even officers there.... And a general...."

"A colonel general," Volodya stated more precisely. "Sure enough, that's Pikalov...."

The soldiers and officers were gathering the fuel and graphite by hand. They were walking along with buckets and picking it up. They dumped the buckets into containers. The graphite was scattered even outside the fence beside our car. I opened the door, stuck the counter of the radiometer almost up against a graphite block. The reading was 2,000 roentgens per hour. I closed the door. There was a smell of ozone, of fire fumes, of dust and of something else. Roasted human flesh perhaps.... When the soldiers would get a bucketful, they would go over to the metal containers with what seemed to me like dilly-dallying. Dear friends, I thought, that is a terrible harvest you are gathering.... The harvest of the last 20 years.... But where did it go? Where are the millions of rubles the state appropriated to develop robotics and manipulators? Where? Were they stolen? Wasted? The faces of the soldiers and officers were dark brown: the nuclear sunburn. The weather forecasters were predicting heavy rains, and so that the radioactivity would not be washed into the soil with the rain, people had come instead of robots, which we did not have. When Aleksandrov, member of the academy, learned about this later, he was indignant: "They are not sparing people at Chernobyl. All of this will come down on me...." But then he had not been indignant when they moved the explosion-prone RBMK into the Ukraine....

The heaps of sand were visible in the distance. The people from Mintransstroy were digging under the reactor at more than one place. They had already cut two tunnels. Then the coal miners would take over from them.

"They are digging under the concrete raft," Volodya said. "They say that under the reactor a bottle of vodka costs 150 rubles.... For decontamination...."

"Let's go!" I commanded Volodya. "Outside, you see, the road up there, along the intake canal. Turn left on it."

Volodya maneuvered onto the road. We passed the ORU-750. The pointer of the radiometer jumped up to 400 roentgens per hour. That was clear—the explosion had hurled fuel here. After about 200 meters, opposite the ORU-330, the pointer fell back to 40. And suddenly.... Damn! The unexpected. The road was blocked, obstructed with concrete blocks. There was no getting through. And the roentgens were ticking off like a clock. To the left of the asphalt was the railroad.

"So now, Volodya, show us what you can do. Turn onto the railroad track and after about 50 meters on the roadbed go off onto that concrete that leads to the ABK-1. Forward!"

The Niva did not let us down. And Volodya did himself proud.

There were several armored personnel carriers alongside the ABK-1. In the open space in front of the entrance, there was a formation of soldiers. In front of the formation, the officer was scolding his subordinates for violating the rules of radiation safety: they were sitting on the ground, they were smoking, they were stripping to the waist to get a suntan, they were drinking vodka, and so on. The officers and the soldiers were not wearing their breathing masks, which were hanging around their necks. The training had been bad, and they were not radiation-literate.... After all, it was from these young lads that the next generation would come. Even 1 roentgen per year yields a 50-percent likelihood of mutation....

"Volodya, you stay here awhile, I will be fast.... Be sure you do not go away, else I will be stuck here."

Seizing the radiometer, I ran into the shelter. It was clean there. Not even background. But stifling. Full of people. Like in a bomb shelter during the war. Desks and beds along the sides for the personnel to rest. Outside, a group of those not on duty were playing dominoes with abandon. You could hear the clicking of the pieces. Here, there were dosimetrists on duty, operators by the telephones who were in touch with the unit control room and the staff

headquarters in Chernobyl. On the wall, there was a map of radiation readings at various places in the industrial area. But I did not need it, I had taken readings. I went up to the second floor of the ABK. Silent and empty. I took the crossover gallery to the 10th level of the deaerator galleries.... Now—fast forward! My target was the Unit 4 control room. I had to see the place where the fatal button of the explosion had been pressed, to see at what level the pointers of the indicators of the position of the control rods had become stuck, to measure the radioactivity at the control panel and nearby, to understand the kind of situation in which the operators had been working....

At a fast pace, almost running, I started along the long corridor toward the damaged unit. It was approximately 600 meters to the Unit 4 control room. Faster....

The radiometer showed 1 roentgen per hour. The needle was slowly crawling to the right. I passed the control rooms of the first two units. The doors were open. I could see the silhouettes of the operators. They were cooling the reactors. More accurately, they were maintaining the reactors in the cooling mode. Unit 3. It had already caught it from the explosion. The radioactivity was 2 roentgens per hour. I went further. There was a metallic taste in my mouth. The drafts could be felt, there was a smell of ozone and fire fumes. Shards of glass broken by the explosion on the plasticized rubber floor. The radioactivity was 5 roentgens per hour. A gap beside the room of the "Skala" complex—7 roentgens. Here was the KRB control room of the second stage—10 roentgens. As though I was going through the passageways and cabins of a sunken ship. To the right, the door to the stairwayelevator well, beyond to the spare control room. On the left, the door to the Unit 4 control room. The people who worked there were now dying at Clinic No 6 in Moscow. I went into the backup control room, whose windows had been blown out onto the pile of debris—500 roentgens per hour. The glass broken by the explosion crunched and screeched under my heels. Back out! I went into the Unit 4 control room. At the entrance, 15 roentgens, 10 roentgens at the work station of the SIUR (of Leonid Toptunov, who was now dying). The arrows on the synchroindicators of the control rods were stuck at a height of 2-2.5 meters. As I moved to the right, the radioactivity increased: 50-70 roentgens per hour. I rushed out of the room and ran toward Unit 1. Quickly...!

So, there it was—the unthinkable had occurred. The peaceful atom in all of its primordial beauty and terrifying power....

Volodya was at his station. The sun, the blue sky, the 30° temperature. The formation of soldiers in front of the entrance had long ago dispersed, the soldiers were sitting in the armored personnel carriers. Smoking. Two of them had stripped to the waist and were sunning. Youth does not believe in death. Young immortals. This was so obvious here. I did not restrain myself, I shouted:

"Boys, you are taking in rems unnecessarily! Is that what they taught you to do?"

A tow-haired soldier smiled, half-rising on the armor plating.

"But we aren't doing anything. We are sunning ourselves...."

"Let's go!"

Toward evening, on 9 May, at approximately 2030 hours, a part of the graphite in the reactor began burning, a void had formed under the load that had been dumped, and that whole cumbersome pile of 5,000 tons of sand, clay, and boron carbide went crashing down, hurling an immense amount of nuclear ash upward from beneath itself. The radioactivity rose sharply at the plant, in Pripyat—in the 30-km zone. The rise in radioactivity was even felt 60 km away in Ivankov and at other places.

In the darkness that had already come on, they took up the helicopter with difficulty and measured the radioactivity.

The ash fell on Pripyat and surrounding fields. On 16 May, I flew off to Moscow.

Testimony of Yu.N. Filimontsev, deputy chief of the Main ScientificTechnical Administration of USSR Minenergo:

"After Chernobyl, we made a trip to the Ignalina Nuclear Power Plant. In the light of the Chernobyl accident, we checked the physics there and the design of the RBMK reactor. The sum of positive reactivity coefficients is still higher than at Chernobyl, in any case no less. The steam coefficient is higher than 2 beta. They are doing nothing about it. I asked them: Why do you not write through channels? They replied: What is the use?

"Nevertheless, the conclusions of the commission concerning reconstruction of all RBMK reactors to improve the safety are being rigidly enforced. Several

official results of investigations have been submitted to the government. Including those of USSR Minenergo, the government commission, and Minsredmash. All outside organizations have arrived at conclusions blaming Minenergo: the operators are at fault, and they do not mention the reactor in any connection. Minenergo, by contrast, submitted more weighty and balanced conclusions, pointing both to the fault of the operating personnel and also to the defective design of the reactor.

"Shcherbina assembled all the commissions and set them to agreeing on a conclusion to be submitted to the Politburo of the CPSU Central Committee."

7

...I am thinking about the dozens of those who died, those whose names we know, and the many unborn, the lives interrupted, whose names we will never learn, since they died because of interruption of the pregnancy of women irradiated in Pripyat on 26 and 27 April.

By 17 May 1986, the VOKhR of USSR Minenergo had buried with military honors in the Mitino Cemetery the 14 men who were casualties in the damaged unit on 26 April and died in Moscow's Clinical Hospital No 6. These were operators and firemen. The doctors continue the fight for the lives of the other serious and less serious patients. Staff members from the headquarters of USSR Minenergo have kept watch in the clinic, helping the medical personnel.

At the beginning of the seventies, I was a patient here on the 9th floor in the ward of Professor I.S. Glazunov. At that time, the building added on the left side was not yet there. The ward was filled with patients with radiation disease. Including some very serious cases.

I recalled Dima, a young man about 30 years old. He had been irradiated while standing .5 meter from the source. He had stood with his back to it and a bit of his right side. The beam was directed downward. The shin, feet, perineum, and buttocks received the maximum effect. He had seen not only the flash itself, but its reflection on the opposite wall and ceiling. Realizing what was involved, he rushed to turn things off. He spent 3 minutes under the conditions of the accident. He took a very sober view of what had happened. He calculated the approximate dose he had received. He arrived at the clinic within an hour after the accident.

His temperature was 39, chills, nausea, excited, eyes glistening. He gesticulated as he spoke, presenting what had happened in almost a joking manner. But very coherently and logically. His jokes made everyone feel a bit awkward. Alert, tactful, and patient.

The day after the accident, they took bone marrow from the patient at four points (the sternum, the iliac bone, both anterior and the left posterior). The average total dose taken by the entire organism was 400 rads. On the 4th-5th day, lesion of the mucous membrane of the mouth, esophagus, and stomach. Ulcers in the

mouth, on the tongue and cheeks, the mucous membrane came off in layers, loss of sleep and appetite. Temperature 38-39, excited, eyes glistening like those of a drug addict. On the 6th day, lesion of the skin of the right shin, edema, a feeling of bursting inside it, numbness, morphine pains.

About 14 billion cells of bone marrow were transfused on the 6th day. They moved the patient to a sterile ward with quartz lamps. The period of the intestinal syndrome began. Stool 25-30 times a day with blood and mucus. Tenesmus, rumbling and overflow in the region of the cecum. No food taken by mouth for 6 days because of the severe lesion of the mouth and esophagus, so as not to injure the mucous membrane. Nutrients administered intravenously.

At the same time, slack painful blisters appeared on the perineum and buttocks. The shin of the right leg was blue-violet, swollen, glistening, smooth to the touch. Epilation (loss of hair) began on the 14th day, and it was also quite strange. All the hair fell out on the right side—both on his head and on his body. Dima himself said that he was like an escaped convict. It was a kind of gallows humor, but he did a great deal to cheer up the other two who had been irradiated with him.

They had gone utterly limp, although the course of the disease in them was unquestionably less severe. Dima would write them humorous notes in verse, but sometimes he broke down and sunk into a sudden depression. For a very long time, he was irritated by loud talk, music, the sound of heels. Once he shouted at a woman physician that the noise of her heels had caused his diarrhea. They did not allow his relatives to see him during the first 3 weeks.

After 40-some days, his condition improved, and they discharged Dima on the 82d day. He still had a deep trophic ulcer (not healing) on his right shin. He limped badly. There was a question of amputating his right leg to the knee....

The second patient was Sergey, 29 years old. He had come from a scientific research institute where he had manipulated radioactive substances in a hot cell. A nuclear flash had occurred because pieces of the substance were brought too close together.

In spite of the vomiting that began immediately, he calculated the approximate dose at 10,000 rads. In half an hour, he lost consciousness. They brought him by plane in an extremely grave condition. Temperature 40, edema of the face, the

neck, and upper extremities. His arms were so large that they could not measure his blood pressure with the usual cuff, the nurses had to lengthen it. He patiently went through the trepan biopsy and punctation of bone marrow. He was conscious. Arterial pressure fell sharply 54 hours after the accident—to zero. Sergey died with acute dystrophy of the myocardium after 57 hours....

The treating physician with whom I became friendly told me: "This was essentially a death caused by the immediate effect of the ionizing radiation. Such patients cannot be saved: The tissue of the heart simply falls apart, cut off by the radiation...."

The third patient, Nikolay, 36 years old, lived 58 days. This was unending torture: the most severe burns (the skin came off in layers), pneumonia, agranulocytosis. What is more, he had extremely severe pancreatitis, and he screamed out loud from the pains in the pancreas. Drugs did not help. He calmed down only after being put to sleep with nitrous oxide.

It was early spring. April it seems. Just like now in Chernobyl. The sun was shining, and it was very quiet in the hospital. I stopped in to see Nikolay. He was lying alone in the sterile room. Alongside the bed was the table with sterile surgical instruments, on another table simbezon, Vishnevskiy's ointment, furacilin, tincture of propolis, sea buckthorn oil, sterile dressing forceps with a little piece of gauze wrapped on it. All of this was to treat the denuded skin.

He lay on a high inclined bed. Above the bed was a framework of steel rods holding the powerful lamps so that he would not be cold, since Nikolay was lying there altogether naked. The oil of sea buckthorn had made his skin yellowish....

But what is this? Nikolay.... Vladimir Pravik.... As though everything had strangely and amazingly repeated itself! Fifteen years later, the same room, the same inclined bed with the framework overhead, the heat lamps, the quartz lamps turned on by a timer....

Vladimir Pravik was lying naked on the inclined bed under the iron framework with the lamps. The entire surface of his body had been burned, it was difficult to distinguish where it had been burned by the fire and where by radiation, it was all merged together. Monstrous edemas outside and inside. Swelling of the lips, the oral cavity, the tongue and esophagus.... The nuclear pain is a special one, it

is insupportable and unsparing, it causes shock and loss of consciousness. The entire body of the heroic fireman was wracked with the nuclear pain. Earlier, they had injected him with morphine and other drugs, which had curbed the pain syndrome for a time. Pravik and his comrades were given intravenous injections of bone marrow. They also received intravenous infusions of extract from the liver of many embryos to stimulate hemopoiesis. But death was not retreating.... He had already had everything: agranulocytosis and the intestinal syndrome and epilation (hair falling out) and stomatitis with severe edema and exfoliation of the mucous membrane of the mouth.... But Vladimir Pravik stoically withstood the pain and the torture. This Slavic Hercules would have survived and conquered death if only his skin had not been killed to its full depth.

And it would seem that in such a state he would not care about the joys and griefs of the world, nor about the destinies of his comrades. He after all was himself at the edge of death. But no! So long as he could still speak Vladimir Pravik attempted to learn what had happened to his friends from the nurses and physicians, how they were, were they alive, were they still continuing the fight, a fight now fought against death. He wanted them to fight, he wanted their courage to help him as well. And when in some inscrutable manner the news would still get through: he has died...he has died...he has died...— like the very breath of death—the physicians would tell the patients that it was not in this hospital, that it was somewhere else, in another hospital.... It was a lie told to save a life.

And then the day came when it became clear: Everything had been done that up-to-date radiation medicine was capable of doing. All the methods of risky and ordinary therapy had been applied to combat the acute radiation sickness, but in vain. Even the most recent growth factors, which stimulate the reproduction of blood cells, did not help. Because a living skin was also necessary. And Pravik did not have even a little piece of it. It had been entirely killed by the radiation. The radiation had also killed the mucous membranes. His mouth had dried up like arid soil. Pravik could not speak, he could only gaze with his eyes and also blink his eyelids without lashes, which had fallen out, he could look, and in his eyes sometimes there flashed fervent reluctance to give in to death. Then, the inner powers of resistance began to weaken and gradually vanished. The dying began, the disappearance of flesh before one's eyes. He began to melt away, to dry up, to disappear. This was mummification of the skin and tissues of the body that had been killed by the radiation. With every hour and every day, the man was becoming smaller, smaller, smaller.

Those who died—the blackened dried up mummies— had become as light in weight as children....

Testimony of V.G. Smagin:

"In Moscow in Clinic No 6 in Shchukinskaya Street, I was first put on the fourth and then on the sixth floor. The more serious patients, the firemen and operating personnel, were on the eighth. Among them, the firemen Vashchuk, Ignatenko, Pravik, Kibenok, Titenok, and Tishchura; the operators Akimov, Toptunov, Perevozchenko, Brazhnik, Proskuryakov, Kudryavtsev, Perchuk, Vershinin, Kurguz, Novik....

"They lay in separate sterile wards with quartz lamps turned on several times a day according to a schedule. The physiological solution which they injected into the veins of all of us in the Pripyat medical unit affected many by lifting their spirits, took away the intoxication caused by the irradiation. Patients with doses less than 400 rads felt best. The others felt only a bit better, they were wracked by severe pains in the skin that had been irradiated and burned by the fire and the steam. The pain in the skin and inside was exhausting, killing....

"The first 2 days, 28 and 29 April, Sasha Akimov came to our ward, dark brown from the nuclear sunburn, severely depressed. He kept saying one and the same thing, that he did not understand why it had exploded. After all, everything was going perfectly, and before he pressed the AZ button there had not been a deviation of a single parameter. That tortures me more than the pain, he told me on 29 April, when he departed forever."

Testimony of L.N. Akimov:

"His parents and brother kept watch beside Sasha. He and Sasha were twins. The brother gave his own bone marrow for the transfusion. While he could still talk, he kept repeating to his father and mother that he had done everything right. This tortured him to the very end. He also said that he had no complaints to make against the personnel of his shift. They had done their duty.

"I visited my husband the day before he died. At that point, he could no longer speak. But there was pain in his eyes. I knew he was thinking about that damned night, he was reenacting everything inside himself over and over again and he could not see that he was to blame. He received a dose of 1,500 roentgens, perhaps even more, and he was doomed. He became blacker and blacker, and on

the day he died he was as black as a Negro. He was charred all over. He died with his eyes open...."

Testimony of V.A. Kazarov, deputy chief of the YPO Soyuzatomenergo:

"I visited Slava Brazhnik on 4 May 1986. He was a young man of 30.1 tried to ask him questions about what happened. After all, at that time it was plain that no one in Moscow knew anything. Brazhnik lay there all swollen, dark brown. He strained to say that his whole body pained terribly and that he was weak.

"He said that first there was a break in the roof and that a piece of the reinforced-concrete slab fell at the 0 level of the turbine hall and broke an oil line. The oil caught fire. While he was trying to put it out and putting on a patch, another piece fell and broke the valve on a feedwater pump. They turned that pump off and disconnected the loop. Black ash flew in through the break in the roof.... He was in a very bad way, and I did not want to ask him any more questions. He was constantly asking for something to drink. I would give him Borzhomi mineral water.

'"The pain, pain everywhere.... The pain is terrible....

'"I did not know,' he said, 'that pain could be so terrible....'"

Testimony of V.G. Smagin:

"I went to see Proskuryakov 2 days before he died. He was lying on an inclined bed. His mouth was horribly swollen. No skin on his face. Bare. Bandages on his chest. Heat lamps above him. He asked constantly for something to drink. I had mango juice with me. I asked if he wanted some juice. He said that he did, very much. He was tired, he said, of the mineral water. A bottle of Borzhomi stood on his bedside table. I helped him to drink the juice from a glass. I left the bottle of juice on his bedside table and asked the nurse to give it to him. He had no relatives in Moscow. For some reason, no one had come to see him....

"The SIUR Lenya Toptunov had his father on watch by the bedside. He had already given his bone marrow for his son's transplant. But it did not help. He stayed at his son's bedside day and night, he would turn him over. He was burned to blackness all over. Only his back was still light-colored. He had gone everywhere with Sasha Akimov, like his shadow. And they burned up identically and almost at the same time. Akimov died on 11 May and Toptunov on the 14th.

They were the first of the operators to die.

"Many who were already considered to have recovered died suddenly. Thus, Anatoliy Sitnikov, deputy chief engineer for operation of the first stage, died suddenly on the 35th day. He had had two transfusions of bone marrow, but it was incompatible, he rejected it.

"Every day those who were recovering would gather in the smoking room of Clinic No 6, and they were all tortured by one thing: Why did the explosion occur? They thought about it and conjectured. They supposed that the explosive mixture of gases could have built up in the coolant drain tank of the safety control system. A puff could have occurred, and the control rods shot out of the reactor. As a consequence, a prompt-neutron excursion. They also thought about the 'tip' effect of the control rods. If the formation of steam and the 'tip' effect coincided—again a runaway reactor and explosion. At some point, they all gradually came to the idea of a burst of power. But, of course, they were not entirely convinced...."

Testimony of A.M. Khodakovskiy, deputy general director of the production association Atomenergoremont:

"By order of the top leadership of USSR Minenergo, I was in charge of the burials of those who died from the Chernobyl radiation. As of 10 July 1986, we had buried 28 persons.

"Many of the bodies were highly radioactive. Neither I nor those who worked in the morgue knew this at first, later we accidentally took a reading and found high radioactivity. We began to wear suits impregnated with lead salts.

"When it learned that the bodies were radioactive, the public health station demanded that concrete rafts be made at the bottom of the graves, as underneath the nuclear reactor, so that the radioactive fluids from the corpses would not go off into the groundwater. This was impossible, blasphemous, we argued with them for a long time. Finally, we agreed that the highly radioactive corpses would be soldered into zinc caskets. That is what we did.

"In Clinic No 6, 19 persons were still being given final treatment as of July 1986, 60 days after the explosion. In one, burn patches appeared suddenly after 60 days when the general condition was fairly good. That was my case." Khodakovskiy pulled up his shirt and showed the dark brown spots of indefinite

form on his abdomen. "These are also burn spots from working with radioactive corpses...."

At this point, I would like to stop and quote excerpts from an article by the American nuclear scientist K. Morgan. I would have quoted words to this effect by A. Aleksandrov or Ye. Velikhov, for example, members of the academy, but they did not utter such words. Here is what Morgan said:

"It has now become obvious that there is no such thing as a small threshold dose of ionizing radiation which would be harmless or from which the risk of illness (even leukosis) would be equal to zero.... Radioactive noble gases (RBG) are the principal source of irradiation of the population during normal operation of a nuclear power plant. Krypton-85, with a half-life of 10.7 years, makes a particular contribution....

"I would like to express great dissatisfaction with the practice of 'burning' and 'scorching' temporary repair workers, which is rather widespread in the nuclear power industry. What is meant by this is the recruitment of poorly instructed and trained personnel for temporary performance of 'hot' (radioactive) operations. Because such personnel do not understand the risk of chronic irradiation, radiation accidents can occur with high probability, and they can inflict harm not only on themselves, but others as well. I consider the practice of 'scorching' personnel profoundly immoral, and until such a practice is repudiated in the nuclear power industry, I will cease to be an active supporter of that industry....

"Over the last 10 or 15 years, new data have shown that the risk of cancer in people affected by radiation is tenfold greater than we calculated in 1960, if not more, and that there is no such thing as a harmless dose...."[7]

And another judgment—that of Andrey Ivanovich Vorobyev, outstanding Soviet scientist, full member of the USSR Academy of Medical Sciences, and a major specialist in the treatment of leukosis:

"I think that humanity's medieval thinking must come to an end after this accident.

"There are a great many things that need to be reassessed today. And although the number of victims of the accident is limited, and most of the casualties have remained alive and will recover, what happened at Chernobyl has shown us the

scale of the disaster that could happen. It must literally reshape our thinking, including the thinking of every individual person, whoever he might be, worker or scientist. After all, no accident is accidental. Which is to say that we must understand that the atomic age requires the kind of precision with which rocket trajectories are calculated. The atomic age cannot be atomic in just one respect. It is very important to understand that people today must know, for example, what chromosomes are just as well as they know what a four-stroke internal combustion engine is. It is not possible to live otherwise. If you want to live in the atomic age—create a new culture, a new way of thinking...."

Testimony of V.G. Smagin:

"Nikolay Maksimovich Fomin, chief engineer of the Chernobyl Nuclear Power Plant, was also treated in Clinic No 6. He spent a month there. I had dinner with him in a restaurant after he was discharged and not long before his arrest. He was pale and depressed. He asked me: 'Vitya, what do you think, what will they do with me? Hang me?' 'Why do you talk like that, Maksimych?' I said. 'Gather your courage, go through with it all to the end....'

"I was in the clinic at the same time as Dyatlov for a time. Before he was discharged, he said: 'They will try me. That is clear. But if they allow me to speak and listen, I will say that I did everything correctly.'

"I met Bryukhanov not long before his arrest. He said: 'No one needs me, I am waiting to be arrested. I went to the general procurator and asked him where I stood and what to do....' 'And what did the procurator say?' 'Wait, he said, you will be called.'..."

They arrested Bryukhanov, Dyatlov, and Fomin in August 1986.

Bryukhanov was calm. He took into the cell with him textbooks and reading matter to study the English language. And he said that he had now been condemned to death like Frunze....

Dyatlov was also calm, restrained.

Fomin lost his grip. He was hysterical. He tried to kill himself in his cell. He broke his glasses and cut his veins with the glass. They noticed it in time. The trial was scheduled for 24 March 1987; it had been postponed because of Fomin's diminished responsibility.

I sought out and had a meeting with Razim Ilgamovich Davletbayev, deputy chief of the turbine shop of Unit 4. As I have already written, he was in the Unit 4 control room at the moment of the explosion. He received more than 300 roentgens during the accident. He looked like a very sick man. He was suffering from radiation hepatitis. His face was very swollen. His eyes did not look well and were very bloodshot. But he bore up admirably. He was in good spirits and composed. In spite of his disability, he was working. A brave man.

I asked him to tell about what happened on that night of 26 April 1986. He said that they had forbade him to talk about the engineering. Only through the first department. I said that I knew everything about the engineering, even more than he did. What I needed were details about the people. But Razim Ilgamovich was sparing: "When the firemen appeared on the turbine hall, the operating personnel were still all there. During the emergency operations in the turbine room, I ran off several times to the control room, and I reported to the shift chief. Akimov was calm, he issued orders straightforwardly. When it began, everyone encountered it calmly. After all, by the nature of our occupation we were ready for something like that. Not to such a degree, of course, but still...." It was obvious that Davletbayev was trying to speak within the limits of what the first department allowed him. I did not interrupt him. He described Aleksandr Akimov, his watch chief: "Akimov was a very orderly and conscientious man. Amiable and sociable. A member of the Pripyat Party Gorkom. A good comrade...." He refused to give a characterization of Bryukhanov. He said: "I do not know Bryukhanov."

He expressed his opinion about the press, which had printed stories from Chernobyl: "It represented us operating personnel as illiterates, almost villains. It was under the influence of the press that all the photographs were torn from the graves in Mitino Cemetery, where our lads are buried. They had spared only Toptunov's photograph. He was still quite young. As though he were inexperienced. They consider us villains. Yet the Chernobyl Nuclear Power Plant generated electric power for 10 years. Not an easy way to make a living, as you know. You worked there yourself...." "When did you leave the unit?" I asked. "At 0500 hours. Acute vomiting began. But we still managed to do things: We put out the fire in the turbine hall, and we displaced the hydrogen from the generator, and we replaced the oil in the turbine oil tank with water. We were not simple operatives. We rethought many things. But at that point the train had already left, I thought of the production process at the moment when the replacements took over. And it was already impossible to stop it. But we were

not simple operatives...."

Yes, in many respects one can agree with Davletbayev. Nuclear operators are not simply operatives. In the process of operating nuclear power plants, they have to make a large number of independent and responsible decisions, frequently very risky ones, in order to save the unit and to come out of an emergency situation or serious transient state with honor. Unfortunately, you will never have instructions and regulations that envisage the entire diversity of every possible combination of states and maladjustments. The experience and professionalism of operating personnel are important here, too. And Davletbayev is right when he says that after the explosion the operators displayed miracles of heroism and fearlessness. They are worthy of admiration.

But this after all was already after the explosion....

The Mitino Cemetery

On the first anniversary of the Chernobyl disaster, I went to the Mitino Cemetery to honor the memory of the firemen and nuclear operators who had been killed. From the "Planernaya" subway station, it is a 20minute ride by bus No 741; an immense city of the dead spreads immediately beyond Mitino village.

The cemetery is quite new, neat, the graves extend over the horizon.

To the left of the entrance is a neat crematorium that is faced with yellow ceramic tile and is continuously in operation, black smoke sped from its stack. To the right of the entrance is the cemetery office.

It is a young cemetery. Trees planted on the graves have still not reached full growth. In the spring, they are dark for the present, they have not leafed out. At various places in the cemetery, flocks of ravens fly up and land on the graves, they are pecking away at the food left on the graves—eggs, sausage, candy....

I walked down the main street of the cemetery. Some 50 meters from the entrance, to the left of the road, are 26 graves with white stone markers. Above each grave, a small marble gravestone with gilt engraving: last name, first name, patronymic, date of birth, and date of death.

The graves of the firemen, six of them, are covered with flowers: vases and pots with living flowers, wreaths of artificial flowers with red ribbons and

inscriptions on them from relatives and those they worked with. On the graves of the nuclear operators, there are not so many flowers and no wreaths at all. The USSR Ministry of Nuclear Power Industry and Minenergo did not even mention those who died on the anniversary of Chernobyl. Yet they were also heroes, they did everything they were able. They showed courage and fearlessness. They gave their lives....

But there are also those who lie here who were on the scene of the tragedy that night by accident and who did not understand the true importance of what happened.

Clear blue sky, sun, warm weather. The croaking of the ravens taking off and landing on the graves, the main street of the cemetery stretching far away to the horizon and people on that street, people going to the graves of those dear to them.

The sounds of shots from automatic weapons were heard not far from where the people from Chernobyl were buried. I looked in that direction. A platoon of soldiers had saluted with kalashnikovs. A man who came up said that they were burying a soldier who had been killed in Afghanistan.

Gold stars were engraved on the gravestones of the firemen. Here lie Pravik, Kibenok, Ignatenko, Vashchuk, Tishchura, Titenok....

There are no signs of distinction on the marble gravestones of the graves of the nuclear operators. Nor are there the photographs which there had been at first. Now, there remains only the photograph on the grave of Leonid Toptunov. Still just a boy, with a mustache, round face, plump cheeks. His father erected alongside the grave a neat and beautiful little bench. It seemed to me that Toptunov had the grave most lovingly cared for.

Twenty-six graves.... The heroic firemen rest in six of them. In the other 20, operators of Unit 4, the electricians, the turbine operators, and the adjusters. Two women—Luzganova and Ivanenko, who worked in the militarized security department. One had been in the passageway opposite Unit 4 and stayed on duty there the entire night until morning. The other was in the KhOYaT (spent nuclear fuel storage) that was under construction—300 meters from the unit. And in these graves there are also true heroes, whose courage saved the plant just as much as the courage of the firemen. I have already spoken about them.

Here they are: Vershinin, Novik, Brazhnik, Perchuk—the machine operators in the turbine hall, who extinguished the fire inside, the fire whose spread would have had horrible consequences for the entire nuclear power plant.

As far as I know, they have not been recommended for awards. Nor has any award been given to Valeriy Ivanovich Perevozchenko, reactor shop shift chief, who did everything possible and impossible to save his subordinates, to get them out of the zones of high radiation.

Nor Anatoliy Andreyevich Sitnikov, deputy chief engineer for operations of the first stage, who had not spared his life in order to understand what actually had happened to the fourth reactor. Nor Georgiy Illarionovich Popov, vibration adjuster from Kharkov, who is lying here and who happened to be there entirely by accident, but he did not leave the turbine hall and in every way he could helped the turbine operators to put out the fire in the turbine hall. Although he could have left and remained alive. Nor has there been an award for the electrician Anatoliy Ivanovich Baranov, who along with Lelechenko localized the emergency situation with the electrical equipment, replaced the hydrogen in the generator, supplied power to Unit 4 when the gamma rays were raging.

Lelechenko is buried in Kiev. He has been awarded the Order of Lenin posthumously.

There is one thing more to be said about awards. The material on awards to the nuclear operators, alive and dead, was prepared under a cloak of silence. Why? one asks.

I walk by the graves, I stop for a long time by each one. I lay flowers at the gravestones. The firemen and six nuclear operators died in horrible pain during the period from 11 to 17 May 1986. They received the highest doses of radiation, they took in more radionuclides than anyone else, their bodies were highly radioactive, and, as I have written already, they were buried in soldered zinc caskets. That was required by the public health department, and I have thought about this with bitterness, since they have prevented the earth from doing its last job—turning the bodies of those who died into dust. This damned nuclear age! Even here, which has been the ending place for human life since time immemorial, traditions thousands of years of old are being violated. Even burial in a human way, commitment to the earth, is impossible. So, this is what it has come to....

But still I say to them: May you rest in peace. Sleep peacefully. Your death has stirred people up, they have come if only an inch out of their lethargy, out of the blindness and grayness of doing what they are told....

Let us bow our heads to them—Chernobyl's martyrs and heroes.

So, what is the main lesson?

The main lesson is a sense of the fragility of human life, its vulnerability. Chernobyl demonstrated man's omnipotence and helplessness. And it issued a warning: Do not become intoxicated with your omnipotence, man, do not play jokes with it. For you are the cause, but you are also the consequence.

In the end, it is this that is more painful than anything: Those chromosome threads severed by the radiation, those genes killed or mutilated, those who have already departed into the future. Departed, departed....

May 1987

Footnotes

1. A. Petrosyants, "Ot nauchnogo poiska k atomnoy promyshlennosti" [From Scientific Exploration to a Nuclear Industry], Moscow, Atomizdat, 1972, p 73.

2. Yu. Sivintsev, "I.V. Kurchatov i yadernaya energe- tika" [I.V. Kurchatov and Nuclear Power Generation], Moscow, Atomizdat, 1980, p 25.

3. Marl is a sedimentary rock consisting of clay and limestone.

4. RBMK—high-power channel reactor.

5. For more detail on this, see G. Medvedev, "Expert Evaluation," DRUZHBA, No 6, 1986.

6. The rem (Russian ber) is the biological equivalent of a roentgen, 1 rem of X-ray irradiation corresponds to 1 rad of absorbed dose.

7. K. Morgan, "Puti umensheniya radiatsionnogo vozdeystviya atomnoy energetiki v budushchem" [Ways of Reducing the Future Radiation Impact of the Nuclear Power Industry], Moscow, Atomizdat, 1980, p 64.

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